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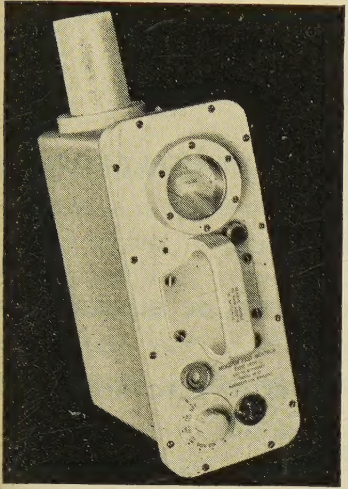

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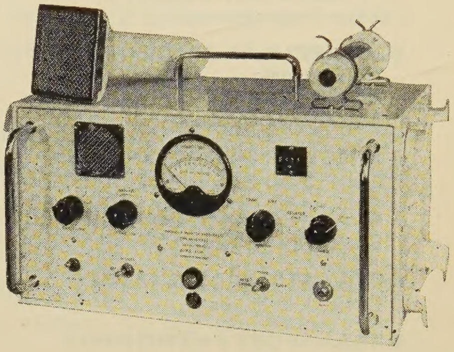

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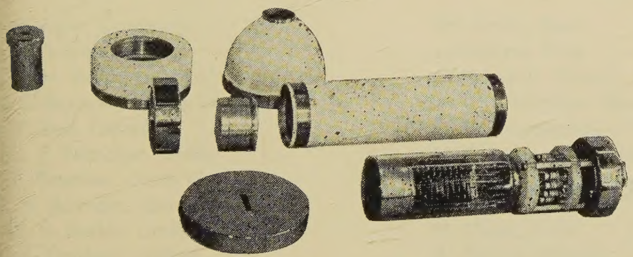

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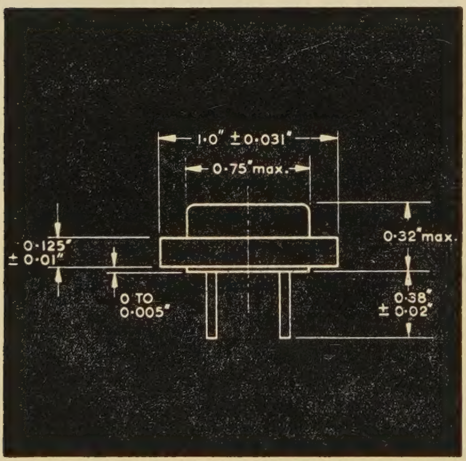
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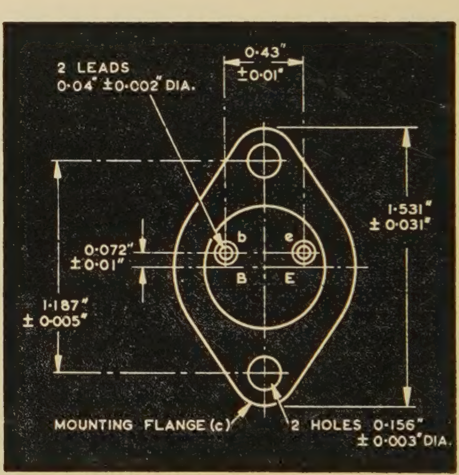
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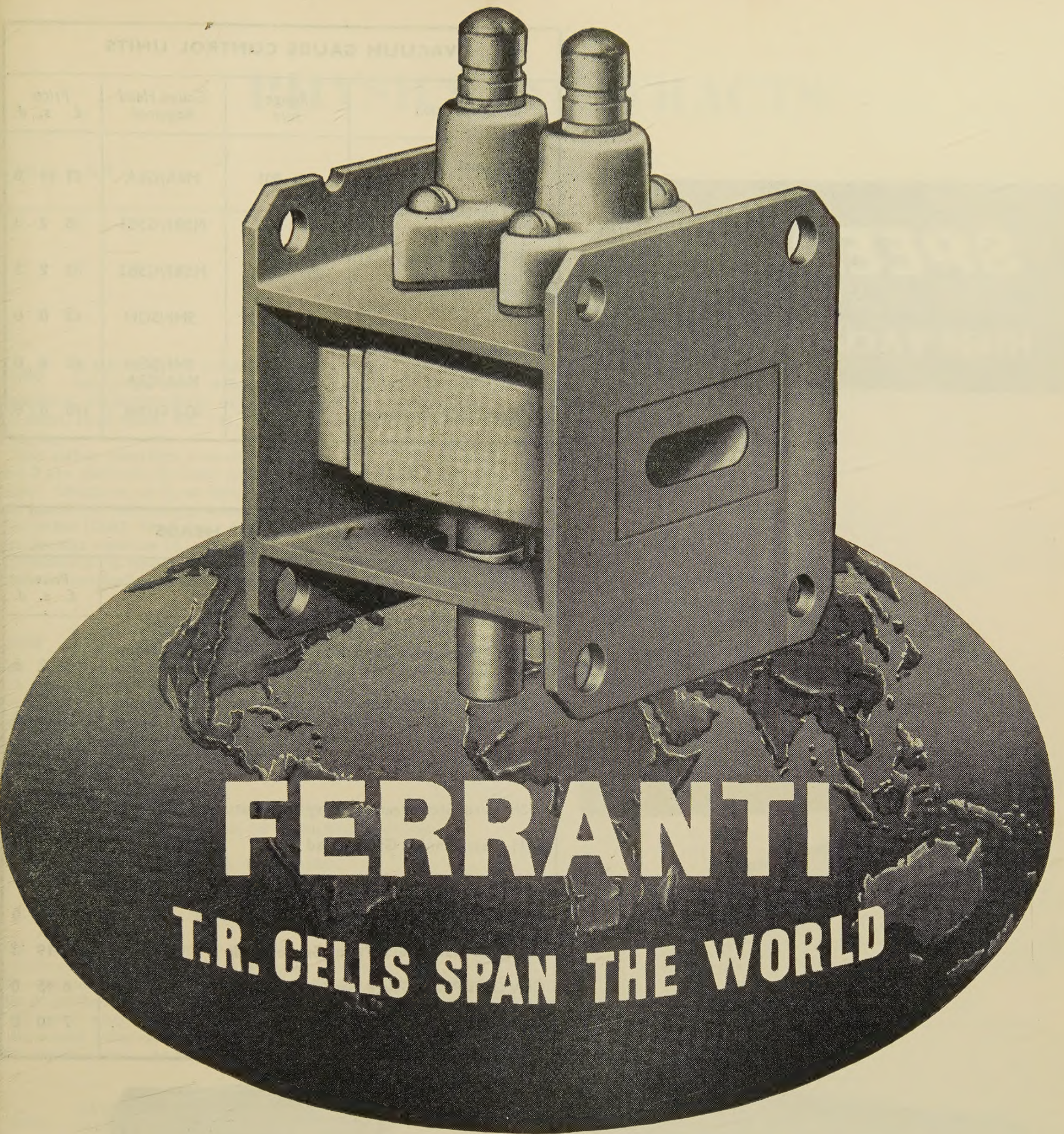
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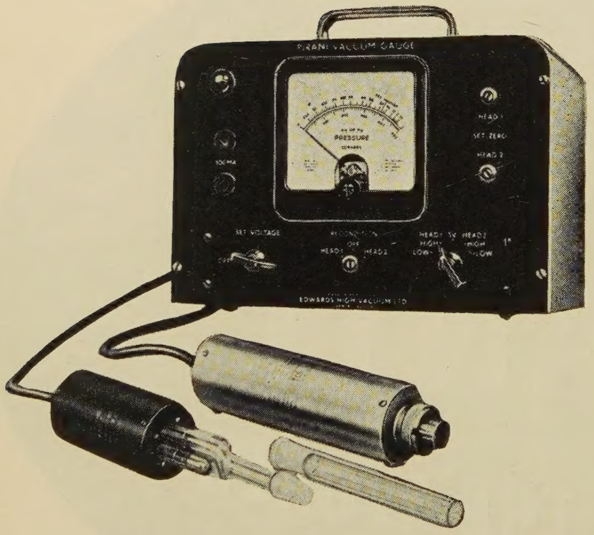
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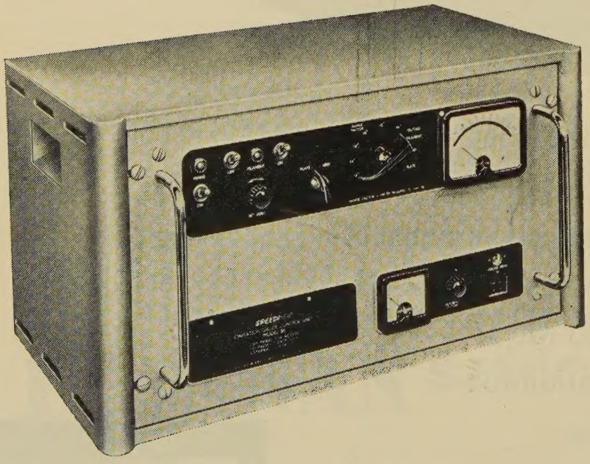

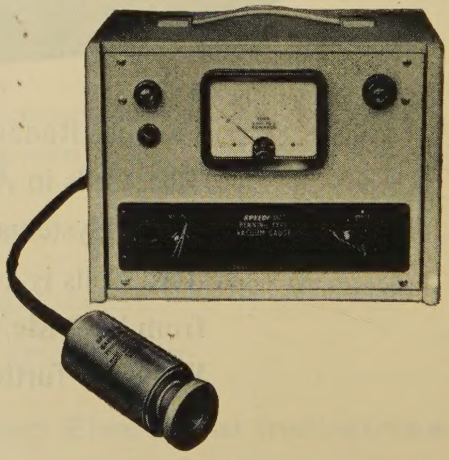
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MATHEMATICS

512

6535 A METHOD OF NUMERICAL SOLUTION AND ANALYSIS OF A HOMOGENEOUS SYSTEM OF LINEAR ALGEBRAIC EQUATIONS OF GENERAL ORDER. L.S.Mayants.

Dokl. Akad. Nauk SSSR, Vol. 131, No. 1, 51-4 (March 1, 1960). In Russian.

The author considers a matrix equation: $(A - \lambda B) X = 0$ where A and B are matrices of order n, X is a vector of order n and λ is a number. Matrix A, or B, or both A and B may be singular. An interation method of solution is described, based on the previous work of the author [Dokl. Akad. Nauk SSSR, Vol. 50, 121 (1945)]. A root of the secular equation $|A - \lambda B| = 0$ is consecutively used to obtain eigenvectors X' of equations of lower order having the same solution of their corresponding secular equations. J.K.Skwirzynski

512 : 530.12

6536 A COMPLEX NON-ANALYTICAL MANIFOLD AND CONFORMAL MINKOWSKI SPACE—TIME. D.K.Sen.

Canad. J. Phys., Vol. 38, No. 1, 145-8 (Jan., 1960).

A general complex manifold and a complex analytic manifold are defined. The Kaehler manifold appears as a complex analytic manifold with a positive definite metric with self-adjoint components. The difference between the Kaehler manifold and the conformal Minkowski space—time is established. T.R.Carson

517 : 534.1

6537 A CONDITION FOR THE EXISTENCE OF ORBITALLY STABLE SOLUTIONS OF DYNAMICAL SYSTEMS.

G.Borg.

K. Tekn. Högsk. Handl., No. 153, 12 pp.(1960).

For the nonlinear system of differential equations

$$\frac{dy}{dt} = f(y),$$

where y and f(y) are vectors in an n-dimensional vector space Rn, a certain contraction property is defined. The following is proved: if the equation has this property, together with some additional regularity properties, and if further the equation has one bounded solution, then it has at least one periodic stable solution, the assumptions and the statement being valid in a given bounded region of the n-dimensional vector space. An extension of the result is also given.

517

6538 RATIONAL APPROXIMATIONS FOR THE DEBYE FUNCTIONS. H.C.Thacher, Jr.

J. chem. Phys., Vol. 32, No. 2, 638 (Feb., 1960).

Satisfactory representations, in the form of ratios of polynomials, are given for the Debye functions,

$$\frac{a}{x^a}\int_0^x \frac{t^a}{e^t - 1}\,dt \qquad (a = 1,2,3,4).$$

for the range $0 \leq x \leq 10$. W.J.Orville-Thomas

517 : 533.6

6539 THE NUMERICAL SOLUTION OF HYPERBOLIC SYSTEMS OF PARTIAL DIFFERENTIAL EQUATIONS IN THREE INDEPENDENT VARIABLES. D.S.Butler.

Proc. Roy. Soc. A, Vol. 255, 232-52 (April 5, 1960).

An original method of integration is described for quasi-linear hyperbolic equations in three independent variables. The solution is constructed by means of a step-by-step procedure, employing difference relations along four bicharacteristics and one time-like ordinary curve through each point. From these difference relations the derivatives of the dependent variables at the unknown point are eliminated. The solution at any point can then be computed, with an error proportional to the step size cubed, without referring to conductions outside its domain of dependence. The application of the method to the systems of equations governing unsteady plane motion and steady supersonic flow of an inviscid, non-conducting fluid is discussed in detail. As an example of the use of the method, the flow over a particular delta-shaped body has been computed.

517 : 539.11

6540 ON THE QUESTION OF THE EXISTENCE OF A DOUBLE SPECTRAL REPRESENTATION. I.P.Pavlotskii.

Dokl. Akad. Nauk SSSR, Vol. 131, 55-7 (March 1, 1960). In Russian.

General conditions on a function $f(z_1,z_2)$ are sought under which the representation (useful in double dispersion relations)

$$f(z_1,z_2) = \int_{-\infty}^{\infty} d\nu_1 \int_{-\infty}^{\infty} d\nu_2 \frac{s_3(\nu_1,\nu_2)}{(z_1 - \nu_1)(z_2 - \nu_2)} +$$

$$+ \int_{-\infty}^{\infty} d\nu_1 \int_{-\infty}^{\infty} d\nu_2 \frac{s_2(\nu_1,\nu_2)}{(z_1 - \nu_1)(z_3 - \nu_2)} + \int_{-\infty}^{\infty} d\nu_1 \int_{-\infty}^{\infty} d\nu_2 \frac{s_2(\nu_1,\nu_2)}{(z_2 - \nu_1)(z_3 - \nu_2)}$$

(where $z_1 + z_2 + z_3 = \text{constant}$) is possible. It is shown that $f(z_1,z_2)$ can be any continuous functional in the space of Fourier transforms of functions u(x,y) satisfying the conditions: u, $\partial u/\partial x$, $\partial u/\partial y$ and $\partial^2 u/\partial x\partial y$ are continuous in each quadrant of the space $W(-\infty < x < +\infty, -\infty < y < +\infty)$, while there may be discontinuities of order one on the lines $x = 0$, $y = 0$; (ii) $x^k y^m u(x,y)$, $x^k y^m \partial u/\partial x$, $x^k y^m \partial u/\partial y$ and $x^k y^m \partial^2 u/\partial x\partial y$ are absolutely integrable over the space W, for arbitrary $k \geq 0$, $k \geq 0$; (iii) on the lines $x = 0$, $y = 0$ the first partial and mixed derivatives of u(x,y), u(−x,y), u(x,−y) and u(−x,−y) are summable. N.L Johnson

517 : 539.2

6541 TABLES OF THE MODIFIED BESSEL FUNCTIONS OF THE SECOND KIND FOR PARTICULAR TYPES OF ARGUMENT. E.Dempsey and G.C.Benson.

Canad. J. Phys., Vol. 38, No. 3, 399-424 (March, 1960).

Tables of the modified Bessel functions of the second kind $K_n(z)$ for arguments z of the form $(\pi/2)\sqrt{q}$ and $(\pi/3)\sqrt{q}$ where q is an integer and for all integral and half-integral orders n in the range 0-10.5 are presented. For all but a small range of the argument the tables can be relied upon to the 10 figures given; in the omitted range an error of unity in the 10th place may occur. The tables should be useful for the computation of many lattice sums arising in the theoretical calculation of crystal properties.

518 : 681.142

6542 UNIFYING DESIGN PRINCIPLE FOR THE RESISTANCE NETWORK ANALOGUE. F.C.Gair.

Brit. J. appl. Phys., Vol. 10, No. 4, 166-72 (April, 1959).

Simplification of design is achieved, without any loss of accuracy, by the use of the "cell principle", which is an extension and generalization of the method of MacNeal. [Quart. appl. Math., Vol. 11, 295 (1953)]. Poisson's equation is integrated over the volume of a representative small cell. In this form it is much easier to appreciate the analogy with the resistance network, and hence to arrive immediately at the relevant design parameters. The method applies not only to the usual type of network with equal meshes, but also to networks with unequal meshes, or subdivided meshes, and further to the representation of the Dirichlet, Neumann or Fourier boundary conditions on rectangular or arbitrarily curved boundaries. More complicated equations than Poisson's can also be represented by a resistance network. By considering these equations as generalizations of Poisson's equation in an appropriate

Riemann space, the corresponding design parameters are achieved This formulation can equally well be used as the basis for any numerical solution of the equations.

518 : 681.142

6543 USE OF AN ELECTRONIC ANALOGUE COMPUTER WITH RESISTANCE NETWORK ANALOGUES.
J.P.K.Altes.
Brit. J. appl. Phys., Vol. 10, No. 4, 176-80 (April, 1959).

A method of solving partial differential equations of the elliptical type, with the aid of an electronic analogue computer in conjunction with a resistance network is given. Although this method is iterative the adjustments are made automatically by means of electronic memory elements and a switching mechanism. Some results are given. In case the iteration process proves to be divergent an additional voltage source connected with a well-chosen node may offer a solution.

518 : 535.31

LENS DESIGNING BY ELECTRONIC DIGITAL COMPUTER.
See Abstr. 5142

518 : 537.533

ANALOGUE STUDY OF TRAJECTORIES IN ELECTRON GUNS.
See Abstr. 5354

518 : 537.54

COUNTER-COMPUTER FOR THE INVESTIGATION OF THE MOTION OF PARTICLES IN AN ELECTRON LINEAR ACCELERATOR. See Abstr. 5367

519

6544 STUDY OF A STATISTICAL MODEL INTRODUCED BY THE TECHNIQUES OF TIME OF FLIGHT OR BY THE STUDY OF FLUCTUATIONS OF THE TIME OF TRANSIT.
A.Blanc-Lapierre and P.Dumontet.
C.R. Acad. Sci. (Paris), Vol. 250, No. 7, 1216-17 (Feb. 15, 1960).
In French.

The problem studied is to deduce the law of random delays fro the study of correlations between a series of events with a Poisson distribution and the series (of events) which is derived from it by separate application to each of the events of independent delays obeying the law sought. H.N.V.Temperley

51

6545 ON OSCILLATORY PARAMETRIC CONTROL.
S.N.Khrushchev.
Dokl. Akad. Nauk SSSR, Vol. 129, No. 3, 522-4 (Nov. 21, 1959).
In Russian.

A description of a possible form of analysis of linear systems with periodic parametric variation. The differential equation for the motion is transformed to one with constant coefficients which ar functions of the parametric frequencies. An extension of the metho to non-linear systems is suggested. J.K.Skwirzynski

519

6546 SELECTED BIBLIOGRAPHY OF STATISTICAL LITERATURE, 1930 TO 1957. I. CORRELATION AND REGRESSION THEORY. L.S.Deming.
J. Res. Nat. Bur. Stand., Vol. 64B, No. 1, 55-68 (Jan.-March, 1960).

519

6547 SELECTED BIBLIOGRAPHY OF STATISTICAL LITERA TURE, 1930 TO 1957. II. TIME SERIES. L.S.Deming.
J. Res. Nat. Bur. Stand., Vol. 64B, No. 1, 69-76 (Jan.-March, 1960).

ASTROPHYSICS

522.6

6548 ON SOME DIFFERENT METHODS FOR PHOTOGRAPHIC MEASUREMENTS OF STELLAR POLARIZATION.
L.O.Lodén.
Ark. Astron., Vol. 2, Paper 11, 111-33 (1957).

Photographic methods for detecting and measuring the interstellar polarization of starlight are discussed, with particular reference to the self-calibrating polarigraph devised by Öhman (1956). Using this instrument results are obtained for NGC 7092, NGC 1664, and also for 13 stars in Selected Area 2. It is concluded that the Öhman polarigraph is a most satisfactory instrument for determining the degree of polarization of the light from relatively faint stars (m_{pg}, 7.0-12.0). D.R.Barber

523

6549 SOME PERIODIC ORBITS IN THE RESTRICTED PROBLEM OF THREE BODIES AND THEIR STABILITIES.
P.J.Message.
Astron. J., Vol. 64, No. 6, 226-36 (Aug., 1959).

Periodic orbits in the restricted problem of three bodies near the exterior case of 2 : 1 commensurability of period have been found by step-by-step numerical integration, using the IBM 650 computer at the Yale University Computing Centre. Periodic orbits with eccentricities up to 0.4 have been traced on the two series of symmetric orbits and also on one of the series of asymmetric orbits, and on one series of symmetric orbits members were traced with eccentricities up to 0.9. For the orbits of all but the largest eccentricities the coordinates are exhibited as Fourier series. The ordinary stabilities of a selection of the orbits of eccentricities up to 0.1 were investigated using a method deriving from Brown's method for the determination of the motion of the lunar perigee. The symmetric orbits of small eccentricity prove to be stable, those of larger eccentricity unstable, and the asymmetric orbits investigated are stable, there being an exchange of stability at the point of bifurcation.

523.14 : 539.12

6550 LOW ENERGY X-RAYS FROM INTERPLANETARY SPACE. L.Reiffel.
Nature (London), Vol. 185, 229 (Jan. 23, 1960).

It is suggested that X-rays may be generated in the region of interplanetary space where the steady gas stream from the sun becomes unstable. Several mechanisms are proposed whereby electrons of energies up to 1 keV may be produced. Considering X-rays in the range 10 to 50 A, a flux of about 3×10^{-8} ergs cm^{-2} sec^{-1} is estimated. This flux should be detectable in observations made fro heights of greater than 120 km on the dark side of the Earth.
R.D.Davies

523.14 : 539.1

6551 AN EXTENSION OF THE $^1\Pi-^1\Sigma$ SYSTEM OF CH$^+$ AND THE IDENTIFICATION OF THE λ 3579 INTERSTELLA LINE. A.E.Douglas and J.R.Morton.
Astrophys. J., Vol. 131, No. 1, 1-7 (Jan., 1960).

The $^1\Pi-^1\Sigma$ system of CH$^+$ has been excited in a hollow-cathode discharge through helium containing a trace of acetylene. In additi to the v'' = 0 progression already known, the v'' = 1 progression has been observed up to and including v' = 4. From the position of the R(0) line of the 3-1 band, the position of the R(0) line of the 3-0 ban has been determined and has been shown to coincide with the hither unidentified interstellar line λ 3579. It is shown that the previously accepted value for the ionization potential of CH is probably incorre

523.1

6552 PRELIMINARY OBSERVATIONS WITH THE STANFOR MICROWAVE INTERFEROMETER. D.D.Cudaback.
Publ. Astron. Soc. Pacific, Vol. 71, 537-9 (Dec., 1959).

The interferometer is a Christiansen cross-type interferomete Each array consists of 16 ten-foot equatorially mounted paraboloid spaced 25 feet apart. The instrument operates in the wavelength range 9 to 11 cm and at 9 cm the fringes from each array are abou 3.5' wide and 41' apart. The east-west grating may be used alone for patrol observations of the sun or the two grating patterns multiplied together to achieve two-dimensional resolution. The equipme is designed for observations on the sun but has been used to observ some of the stronger of the localized sources. C.Hazar

523.16

6553 RADIO EMISSION FROM JUPITER AT A WAVELENGTH OF 31 CENTIMETRES. J.A.Roberts and G.J.Stanley.

Publ. Astron. Soc. Pacific, Vol. 71, 485-96 (Dec., 1959).

A mean value of 5500°K was found for the equivalent disc temperature of Jupiter at 31 cm. The individual measurements showed considerable scatter, but no correlation was found with Jovian longitude or solar flare index. Comparison with other observations of Jupiter on different wavelengths, indicates that the apparent disc temperature rises rapidly with increasing wavelength but the flux density remains sensibly constant. Both free-free transitions and synchrotron processes are considered as possible causes of the observed radiation, but insufficient evidence is available to decide which mechanism is operative. H.J.A.Chivers

523.16

6554 OBSERVATIONS ON THE SOLAR ECLIPSE OF OCTOBER 2 [1959].

J.Aarons, J.P.Castelli, R.M.Straka and W.C.Kidd.

Nature (London), Vol. 185, 230-1 (Jan. 23, 1960).

The eclipse was observed at Cambridge, Mass., at frequencies of 224, 1300 and 3000 Mc/s. Totality occurred where the sun was at an elevation of 1°. The residual energy recorded at 224, 1300 and 3000 Mc/s during totality was 35, 20 and 20% respectively of the uneclipsed sun. Exceptionally deep scintillations were recorded on 1300 and 3000 Mc/s while two active plage areas, which acted as point sources, were uneclipsed. The shadow patterns observed at these two frequencies were closely correlated. No scintillations were observed at 224 Mc/s. R.D.Davies

523.16

6555 RADIO RADIATION FROM THE SUN AT DIFFERENT PHASES OF THE SOLAR CYCLE.

Débarbat and J.C.Pecker.

Ann. Astrophys., Vol. 21, No. 5, 250-9 (Sept.-Oct., 1958). In French.

Detailed comparisons are made of the observed asymmetries of radio-eclipse flux measurements with values computed from the circumstances of the eclipse in relation to the Moon's transit of the solar disk, and corona. Useful data is derived concerning the characteristics of solar activity at centimetre wave lengths with respect to the optical activity of the corona at different epochs of the 11-yr sunspot cycle. D.R.Barber

523.16

6556 LOW-FREQUENCY SOLAR BURSTS AND NOISE STORMS. A.Boischot, R.H.Lee and J.W.Warwick.

Astrophys. J., Vol. 131, No. 1, 61-7 (Jan., 1960).

East-drift, or type III, bursts in the frequency range 15-38 Mc/s have been observed. Such bursts account for most of the solar emission observed in this spectral range. While fast-drift bursts last only a few seconds at metric wave lengths, they may persist for half minute or more in the decametric region and show only a relatively small variation in frequency with time. A physical interpretation of the duration of the bursts suggests that they occur in a region of steep temperature gradient. Their breadth in frequency indicates excitation by quasi-relativistic particles leaving the sun. At intervals of several weeks steady noise sources were also observed generally persisting for several days. The spectrum of these sources is a continuum, crossed occasionally by a few bursts and ionospheric scintillations. The source often show discountinuous variations in position from day to day. On one occasion, June 3, 1959, a source moved with a velocity of the order of 850 km/sec.

523.16

6557 PERIODICITIES IN SOLAR RADIO NOISE EMISSION. N.C.Gerson.

Austral. J. Phys., Vol. 12, No. 3, 299-300 (Sept., 1959).

A short note indicating that periodicities recently observed in solar radio wave emissions between 2 and 30 Mc/s were also present in earlier observations at higher frequencies. C.Hazard

523.16 : 537.59

6558 SOLAR RADIO BURSTS AND LOW-ENERGY COSMIC-RAYS. A.R.Thompson and A.Maxwell.

Nature (London), Vol. 185, 89-90 (Jan. 9, 1960).

The arrival of low-energy cosmic rays (30-300 MeV), as indicated mainly by the onset of polar blackouts, appears to be correlated with spectral Type IV solar radio bursts. There is a significant western excess in the heliographic distribution of solar flares associated with these continuum bursts. H.J.A.Chivers

523.16

6559 RELATION BETWEEN THE POSITION AND THE SENSE OF POLARIZATION OF SOLAR RADIO STORMS.

A.M.Malinge.

C.R. Acad. Sci. (Paris), Vol. 250, No. 7, 1186-8 (Feb. 15, 1960). In French.

It has been found that radio noise storms originating in the northern hemisphere of the sun are nearly all right circularly polarized. Those from the southern hemisphere are left circularly polarized, whilst storms originating near the equator appear to have variable polarization characteristics. Most storms originate in the northern hemisphere and the polarization results reported are in opposite sense to measurements made in the last sunspot cycle. H.J.A.Chivers

523.16

6560 POLARIZED BURSTS AND NOISE STORMS OF SOLAR RADIO EMISSION. II. STORM BURSTS AND BACKGROUND CONTINUUM. T.Takakura.

Publ. Astron. Soc. Japan, Vol. 11, No. 2, 55-70 (1959).

For Pt I, see Publ. Astron. Soc. Japan, Vol. 8, No. 3-4, 182 (1956). An attempt is made to explain the so-called background continuum of the noise storms as the superposition of many spikes which have an identical shape, occur at random and whose amplitudes are distributed according to a probability density. If two parameters, the frequency of occurrences of bursts and the range of distribution of the amplitude, change with time as it is likely to do, almost all noise storms are in fairly good agreement with the present hypothesis. In this case, so-called "storm bursts" are fluctuations about a mean level and the superposition of at least a few spikes.

523.16

6561 POLARIZED BURSTS AND NOISE STORMS OF SOLAR RADIO EMISSION. III. THE POST-DETECTION LOW FREQUENCY SPECTRA OF NOISE STORMS. T.Takakura.

Publ. Astron. Soc. Japan, Vol. 11, No. 2, 71-8 (1959).

The hypothesis that the background continuum of noise storm is a superposition of many spikes is ascertained by measuring the post-detection low frequency spectra of noise storms. The profile of the low-frequency spectrum ranging from 0.3 to 30 c/s is independent on the intensity of the continuum and the amplitude of fluctuations. The spectrum is consistent with the present hypothesis, if the noise storms are a superposition of many spikes each of which has a shape which rises linearly with time to its maximum intensity and declines exponentially with a time constant of the order of one second.

523.16 : 523.75

OPTICAL OBSERVATIONS OF THE SOLAR DISTURBANCES CAUSING TYPE II RADIO BURSTS. See Abstr. 4900

523.16

6562 GEOMAGNETIC DISTURBANCE AND VELOCITY OF SLOW DRIFT BURSTS. M.B.Wood and C.S.Warick.

Nature (London), Vol. 184, 1471-2 (Nov. 7, 1959).

Frequency drift rates for Type II solar radio bursts have been determined for radio spectral observations. When plotted against the frequency at which the bursts begin, the slope of the curve obtained can be interpreted as a change in velocity with height in the solar atmosphere. It has been found that bursts followed by geomagnetic disturbances indicate a larger acceleration than is present in those bursts not followed by geomagnetic disturbances. In this way, the bursts can be related to streams of particles which escape from the sun in one case, but fail to escape in the other. H.J.A.Chivers

523.16

6563 THE EXTENDED COMPONENT OF CENTAURUS A. C.M.Wade.

Austral. J. Phys, Vol. 12, No. 4, 471-6 (Dec., 1959).

Observations on 19.7 Mc/s, 85.5 Mc/s and 1400 Mc/s all indicate that the Centaurus (13S4A) radio source consists of a small intense source surrounded by a weak extended source. An attempt has been made to remove the effects of the central source in the 85.5 Mc/s isophotes, and this process reveals two broad maxima in the extended background. The similarity of this distribution with that of the Cygnus (19N4A) source is pointed out. H.J.A.Chivers

523.16

6564 A SEARCH FOR RADIO EMISSION AT 3.5 m FROM THE LOCAL SUPERGALAXY. E.R.Hill.

Austral. J. Phys., Vol. 11, No. 4, 580-3 (Dec., 1958).

An investigation of the region of sky covering the Virgo cluster of galaxies shows no evidence of radio-emission associated with the cluster, which is considered by some authors to be the direction of the centre of a local supergalaxy. It is shown that a band of radiation previously reported in this region does not coincide with the concentration of bright galaxies but appears rather to be part of a well-known galactic feature which obscures any radiation which might be associated with the "supergalaxy". C.Hazard

523.16

6565 ELEVATION, HEIGHT, AND ELECTRON DENSITY OF ECHOING POINTS OF METEOR TRAILS. A.A.Weiss.

Austral. J. Phys., Vol. 12, No. 1, 65-76 (March, 1959).

Continuous and systematic operation of a c.w. equipment which measures simultaneously several characteristics of meteor echoes, including the location in space of the reflection point, provides the basic material for an examination of the geometry of detection of meteor trails by radio equipments and of the processes underlying selection of echoes for measurements of different kinds. At least 60 per cent of all echoes are distorted in some degree, presumably by atmospheric turbulence or by non-specular reflection. This and selection in height due to diffusion of the trail are the two most important selection processes. The distribution of the echoing points of sporadic meteors, in zenith angle and in height, is compared with theoretical expectation. Height distributions found for Arietid and ζ-Perseid meteors agree with other measurements. The height distribution for the Geminid shower is unexpectedly narrow, a fact for which no satisfactory explanation can be advanced. Distributions of electron line densities at reflection points agree qualitatively with known mass distributions and trail shapes.

523.16

6566 THE LIMITATIONS OF NARROW-BEAM RADIO EQUIPMENTS IN THE DETECTION OF WEAK METEOR SHOWERS. A.A.Weiss.

J. atmos. terrest. Phys., Vol. 14, No. 1-2, 19-30 (April, 1959).

At the echo rates practicable for a routine survey of meteor activity using a narrow-beam radio equipment, it is shown that the chief limitation to the recognition of weak shower activity is the fluctuations in the rate of detection of background (sporadic) meteors. Examination of echo rates obtained with the Adelaide 67 Mc/s equipment for December 1956 and January 1957 confirms that over short intervals of time the background fluctuations are random. A significance test, intended for use as a search method for weak shower activity and non-random fluctuations in the background activity, is then developed. This test, based on echo rates, is applied to the data for December 1956 and January 1957.

523.16

6567 MULTIPHASE RADIO INTERFEROMETERS FOR LOCATING THE SOURCES OF THE SOLAR RADIO EMISSION. S.Suzuki.

Publ. Astron. Soc. Japan, Vol. 11, No. 4, 195-215 (1959).

Multiphase radio interferometers, devloped for the purpose of minimizing the ambiguity and simplifying the reduction procedure in locating the sources of the solar radio emission, are discussed. By simple eye-estimation, the relative position can be deduced with an accuracy of 0.01 solar radii.

523.3

6568 FIRST RESULTS OF PHOTOGRAPHING THE SIDE OF THE MOON INVISIBLE FROM THE EARTH.

N.P.Barabashov and Yu.N.Lipskii.

Dokl. Akad. Nauk SSSR, Vol. 129, No. 5, 1000-2 (Dec. 11, 1959). In Russian.

Three photographs of the far side of the moon selected from a large number taken over a period of 40 minutes, at distances varying from 65 200 km to 68 400 km, with a camera having two objectives, focal lengths 20 cm and 50 cm. Experimental details are published elsewhere (see following abstract). Descriptions of the photographs are given, and the names of new regions. Mountainous regions appear to predominate whilst the maria are relatively very small. G.A.Chisnall

523.

6569 THE OTHER SIDE OF THE MOON. Translated from the Russian by J.B.Sykes.

London: Pergamon Press (1960) 36 pp., 4 photographs, 5 diagrams

This is a translation of the offical announcement published by the U.S.S.R. Academy of Sciences after the first sucessful photogra ing of the far side of the moon. A photograph and diagram of the automatic interplanetary station are given, with rough dimensions and an outline description of the mechanism. The orbit is discusse with diagrams, and a description given of the arrangements for pho graphing the far side of the moon, developing the film, and transmit ting it. Three photographs of the unseen side are included, with names and discussion of the features shown on them.

523.

6570 THE FIGURE OF THE MOON. G.Schrutka-Rechtenstamm and J.Hopmann.

S.B.Osterr. Akad. Wiss. mat.-nat. Kl. Abt. II., No. 8-10, 283-90 (1958). In German.

Describes a new lunar relief map based on absolute height measurements (in km) at 150 reference points on the Moon's disk, derived from five Lick Observatory plates, and visual estimates by J.Franz, Breslau (1901). A weak correlation is shown to exist between 23 high, and low reference points and the so-called "Continents", and "Maria"; the latter being 1-2 km lower on the average than the former. The remaining 127 measures show little scatter, and indicate a spherical figure for the Moon (as observed from the earth) within the error of measurement. D.R.Barbe

523.

6571 ON THE FORMATION OF RAPIDLY ROTATING ASTEROIDS. E.Rabe.

Astrophys. J., Vol. 131, No. 1, 231-40 (Jan., 1960).

It is shown, on the basis of the energy integral of the lunar or stellar type of the three-body problem, that, in consequence of accretion and orbital friction relative to nebular matter, the develo ment of dynamically unstable pairs of asteroid condensations into stable binary configurations would have been possible during the early formative period, before the dissipation of the solar nebula. Continued accretion and friction would have caused the components of such stable pairs to spiral in toward each other, until contact and the formation of one combined, rapidly rotating body was achieved. If the condensations had a density of 2.0 g/cm^3, the minimum period of rotation of asteroids formed in this manner would amount to abou 4.7 hr, which is in close agreement with the observed periods.

523.

6572 RADIOMETRIC OBSERVATIONS OF MARS. W.M.Sinton and J.Strong.

Astrophys. J., Vol. 131, No. 2, 459-69 (March, 1960).

Radiometric temperature measurements of Mars were made with the 200 in. reflector in 1954. The radiometry utilized filters that isolate bands of radiation within the 8-13 μ "window". This broad-band radiometry was augmented with spectra obtained with moderately good resolution with a grating spectrometer. The temperature of Mars at the centre of the disk was found to be 15°C. Scans across the planet providing good signal-to-noise ratios were made with an aperture as small as 1.5 seconds diameter. Several interesting phenomena were found and correlated with their appearance on photographs. The temperature of a yellow cloud, which appears on photographs taken by others, was −25°C. Dark areas were a few degrees warmer than adjacent bright regions. From several of the scans the diurnal temperature variation was determined, and this has been compared with that derived from the theo of surface heat conduction. It is found that no choice of the therma constants will give agreement in both phase lag and amplitude simultaneously. The reason appears to be the presence of the Martian atmosphere, which is ignored in the theory. The bands of carbon dioxide at 9.4, 10.4, and 12.6 μ have been found in the Martian spectrum. From the spectrum it may be said that silicate are not present on the surface in large proportions.

523.

6573 RADIOMETRIC OBSERVATIONS OF VENUS. W.M.Sinton and J.Strong.

Astrophys. J., Vol. 131, No. 2, 470-90 (March, 1960).

Modern infrared techniques were applied to the measurement thermal radiation and temperatures of planets. The two nearest planets have the maximum of their thermal emission within the

13 μ band that is transmitted by our atmosphere with relatively ttle absorption. The transmission of the atmosphere was deterined by extrapolation of observed planetary emission to outside e atmosphere, using the square-root law. Calibration of the equipent was made with black bodies. The method of determining atospheric transmission was tested in the laboratory with an mmonia cell, to simulate a planetary atmosphere, and a rock, to mulate a planet. Radiation temperatures for the rock within a few grees of the thermometer temperature were obtained in these sts. Extensive measurements were made of Venus with the 200 in. lescope in 1953, and further measurements were made in 1954. he temperature at the centre of the disk was found to be -39°C. ans near dichotomy show that the dark side of the disk is nearly hot as the bright side. There is also substantial limb darkening. cold region found at the north cusp in 1953 appears to be related a bright cloud found in ultraviolet photographs taken on the same te. Spectra of Venus between 8 and 13 μ were obtained with prism d grating spectrometers. A diffuse band at 11.2 μ was found in e spectrum of Venus in addition to a carbon dioxide band at 10.4 μ. he 10.4 μ band was found much weaker than expected.

523.4 : 535.22

6574 VELOCITY OF LIGHT AND MEASUREMENT OF INTERPLANETARY DISTANCES. M.J.E.Golay.

ience, Vol. 131, 31-2 (Jan. 1, 1960).

The combined availability of atomic clocks and of instrumented anetoids travelling in their own solar orbits will offer the possiility of determining their distance from the earth and hence interanetary distances, in terms of the wavelength of the radiation of omic frequency standards. It can be anticipated that the accuracy these measurements will be very high and will not depend upon the ss accurate knowledge of the velocity of light in terms of the stanrd metre, the sidereal second, and so on.

523.5

6575 AURORAL GREEN LINE IN METEOR WAKES. I.Halliday.

strophys. J., Vol. 131, No. 1, 25-33 (Jan., 1960).

The auroral green line (λ 5577) has been found in twelve meteor pectra photographed from 1955 to 1958. It is normally confined the top portion of the photographed trail with an extreme height ange of from 120 to 79 km. At times of increased solar activity he line appears to persist to lower heights. Only fast meteors have een observed to produce the line. The excitation mechanism is bscure but probably involves ionization of either atmospheric or eteoric origin. The lack of any perceptible decay in the breaks hen spectra are photographed through a rotating shutter indicates hat de-exciting collisions are less frequent than 5 per second. here is no evidence to support the presence of λ 5577 in longnduring meteor trains.

523.5

6576 A TIME-RESOLVED SPECTRUM OF THE TERMINAL BURST OF A PERSEID METEOR. J.A.Russell.

strophys. J., Vol. 131, No. 1, 34-7 (Jan., 1960).

A grating spectrum of the terminal burst of a Perseid meteor as obtained in 1956 that shows marked changes in the relative ntensities of low-excitation and high-excitation iron lines in the ourse of the burst. The possible relationship of this phenomenon that of the spectra of meteoric wakes is considered. The Perseid pectrum is compared with the spectrum of a sporadic meteor btained on the same roll of film.

523.5

6577 THE ELECTRIC DISCHARGE DURING THE FLIGHT OF METEORS IN THE EARTH'S ATMOSPHERE.

.P.Dokuchaev.

okl. Akad. Nauk SSSR, Vol. 131, No. 1, 78-81 (March-April, 1960).

It is suggested that ionization produced in flight leads to enancement of the electric field near the meteor. When the field is o high that corona develops, a luminous halo is observed around he meteor. At still higher fields the corona discharge goes over o the spark discharge leading to micro-pulsations in the earth's agnetic field.

Z.Krasucki

523.5

6578 THE VELOCITY OF METEORS DURING THEIR EVAPORATION. F.Verniani.

icerca sci., Vol. 29, No. 9, 1965-70 (Sept., 1959). In Italian.

Using Herlofson's equations of meteoric evaporation (Abstr. 2881 of 1949), it is shown that part of a meteor cannot completely evaporate because of the loss in speed, and that the flight of all the meteors in the atmosphere is considerably retarded during evaporation.

523.5

6579 THE COSMIC AGE OF THE SIKHOTE-ALIN' METEORITE. É.K.Gerling and L.K.Levskii.

Dokl. Akad. Nauk SSSR, Vol. 130, No. 1, 45-6 (Jan. 1, 1960). In Russian.

The measured contents of H^3 and A^{39} in this meteorite lead to estimates for its cosmic age of $(900 \pm 200) \times 10^6$ years and $(430 \pm 50) \times 10^6$ years respectively. Experimental details are not given here. The results are used to calculate the density of the irradiating cosmic-rays to be about 2.3 particles $cm^{-2}sec^{-1}$.

G.A.Chisnall

523.5

6580 HELIUM IN STONE METEORITES. P.Eberhardt and D C.Hess.

Astrophys. J., Vol. 131, No. 1, 38-46 (Jan., 1960).

The helium in thirteen stone meteorites was measured by isotopic dilution. The He^4 ages for seven chondrites range from 1.0 to 4.4 billion years. "Cosmic-ray ages", deduced from the He^3 content are lower by several orders of magnitude.

523.5 : 537.59

6581 TRITIUM MEASUREMENTS ON STONE METEORITES. K.Goebel and P.Schmidlin.

Z.Naturforsch., Vol. 15a, No. 1, 79-82 (Jan., 1960). In German.

Some calculations are made on the particle current density of cosmic rays based on the tritium content of seven meteorites. For six of them the values obtained range between 0.58 and 0.75 particles sec^{-1} cm^{-2} $sterad^{-1}$.

J.M.Hough

523.5

6582 COSMIC DUST IN RECENT DEEP-SEA SEDIMENTS. W.Hunter and D.W.Parkin.

Proc. Roy. Soc. A, Vol. 255, 382-97 (April 16, 1960).

By means of a simple density-measuring technique, black magnetic cosmic spherules, found in the deep-sea surface sediments, can be divided into two main groups. Further analysis shows the spherules of the first group (density about 3) to be a fine-grained magnesium-rich olivine; and those of the second group (density about 6) to be a partially oxidized nickel + iron alloy. These results strongly indicate a meteoritic origin, and, following Öpik (1956), it is suggested that the spherules are derived from the Zodiacal Cloud. The expected amount of zodiacal material accreted to the earth is in fair agreement with direct observation, and it is tempting to regard the cloud as a swarm of small dust flakes produced by the collision of meteoritic (or asteroidal) bodies. Interaction with the upper atmosphere, at speeds near the earth's escape velocity, would cause some of the larger flakes to melt, and in the case of olivine this would account for its blackened magnetic state. Only the magnetic fraction of the sediments have been examined; it is not known whether other extra-terrestrial material is present in the non-magnetic portion. Over 260 spherules were extracted from two Atlantic samples and one Pacific sample. A very simple method for comparing the recent rates of sedimentation for the various parts of the oceans is suggested. The size is distributions of the spherules are discussed in terms of Whipple's micro-meteorite theory. The minimum size of the iron spherules, occurring at about 15 μ diameter, is used to account for an unexpected depression or "forbidden region" in the stony size distribution near 60 μ. Since the smallest stony spherules found were about 18 μ, it may be suspected that our observations were limited to sizes above about 15 μ. This may be true, as settling-out techniques had to be used in order to rid the sediment of fine magnetic grains, particularly troublesome in the Atlantic samples. However, on occasions the settling process was omitted for the Pacific sediment and careful attention paid to the smaller particles; no spherules below about 15 μ could be found. It is very important to obtain the correct lower limit of the size distributions, and the examination of magnetite-free sediments would be extremely helpful in any future work.

523.72 : 537.59

6583 ON THE ORIGIN OF TERRESTRIAL PARTICLES FROM SOLAR FLARES. W.H.Ward.

J. atmos. terrest. Phys., Vol. 14, No. 3-4, 296-8 (June, 1959).

A mechanism which might lead to ejection of charged particles from the sun is suggested. It arises from the local cancellation of the magnetic field of a pair of sunspots by a general field.

523.72

6584 ON THE EMISSION CURVES OF GROWTH OF Fe I AND Ti II IN THE LOWER CHROMOSPHERE. I.Kawaguchi.

Publ. Astron. Soc. Japan, Vol. 11, No. 3, 138-50 (1959).

Under the assumption of pure absorption mechanism, the density and temperature distributions in the lower chromosphere are derived by the method of emission curves of growth, taking the turbulent velocity distribution observed by Redman and Suemoto into consideration. The density distribution thus obtained seems reasonable as judged from the observed behaviour of Sr II resonance lines 4077 and 4215 A. It seems improbable that the flash lines are formed by pure absorption mechanism, according to the following reasons: (i) The radiation temperature 5200°, deduced from the emission curves of growth, is considerably different from the excitation temperature 4150°, derived empirically. (ii) On the basis of density distribution derived here, the centre of some strong Fraunhofer lines of Ti II will be formed in the lower chromosphere. The radiation temperature 5200° is much higher than that derived from the residual intensities of these lines under the assumption of pure absorption.

523.74

6585 ON SOLAR GRANULATION.

F.N.Edmonds, Jr.

Astrophys. J., Vol. 131, No. 1, 57-60 (Jan., 1960).

From the examination of high-quality stratoscope photographs of solar granulation it has been determined that the fading of the granulation pattern occurs primarily in the region $60^\circ < \theta < 78^\circ$ and that the fading granulation is replaced by a larger, low-contrast pattern observable out to $\theta \cong 87^\circ$. Inhomogeneities in the granulation pattern have also been observed. These consist of low-contrast regions which seem to persist for periods longer than 10 minutes and small-scale regions which seem to evolve with the normal pattern.

523.74

6586 OBSERVATIONS OF CHANGES IN THE PHOTOSPHERIC GRANULES. R.J.Bray and R.E.Loughhead.

Austral. J. Phys., Vol. 11, No. 4, 507-16 (Dec., 1958).

Using a sequence of 29 good-quality photographs extending over a period of 10 min, an attempt is made to detect changes in the brightness, size, and shape of individual granules. Of the 125 granules for which there is sufficient data, 57% show no detectable change during their observed periods of persistence, an additional 14% showing only minor changes of shape. Although there is some tendency among granules showing change for size increases to predominate over decreases, brightness increases and decreases occur with equal frequency. There is no correlation between the two types of change, nor is there any tendency for brightness or size variations to occur during any particular part of the life cycle. Observations with higher resolving power are required to elucidate the changes occurring during the formation and dissolution of individual granules. In agreement with Macris (1953), earlier estimates of the lifetimes of the granules are found to be too low. It seems likely that the true value for the most probable lifetime exceeds 7-8 min.

523.74

6587 OBSERVATIONS OF FACULAE BORDERING SMALL SUNSPOTS NEAR THE LIMB.

R.E.Loughhead and R.J.Bray.

Austral. J. Phys., Vol. 12, No. 1, 97-9 (March, 1959).

A description (with 2 illustrations) of bright facular features bordering the limb-ward edges of small umbral spots near the solar limb (at heliocentric angles between 55° and 65°). The association of bright facular borders with spot groups is not invariable : many spots at favourable heliocentric angles have no such features. One possible interpretation of the phenomenon is that the faculae lie over the spot umbrae at an effective height of ~ 1200 km, and so appear in perspective to be displaced relative to the spot centres. Whatever is the true explanation it seems certain that the hotter facular clouds actually overly the cool umbral regions. Both features thus form a physical entity that acts as a refrigerating engine.

D.R.Barber

523.74

6588 ON THE CORRELATION BETWEEN OBSERVATIONS OF MAGNETIC FIELDS OF SUNSPOTS AT MT. WILSON POTSDAM AND THE CRIMEA. O.Steen and P.Maltby.

Astrophys. Norveg., Vol. 6, No. 10, 113-22 (Sept., 1959).

The correlation coefficients and the regression lines are determined for two observatories at a time. The highest correlatio coefficient is found between observations at Mt. Wilson and Potsdam The correlation between observations made on the same day at Mt. Wilson and Potsdam is found to be higher than that between determinations of the maximum strength of the magnetic field of thes sunspot. Some possible interpretations of the results are discussed As only few simultaneous observations are available at present, some of the results should be re-examined with sufficient statistical material.

523.74

6589 FILAMENTARY STRUCTURE BETWEEN SUNSPOTS PHOTOGRAPHED IN INTEGRATED LIGHT.

R.A.Miller.

J. Brit. Astron. Assoc., Vol. 70, No. 2, 100-1 (Feb., 1960).

On a patrol plate of the solar disk photographed in integrated light at the Manila Observatory, Phillipines, on 5 November, 1958, filamentary structure was plainly visible between the components o a complex spot group. The pattern suggested an orientation in the magnetic field of the bipolar spots. The penumbral filaments were not visible on a Mount Wilson Hα spectroheliogram taken $6\frac{3}{4}$ hours previously. It is a rare occurrence for filaments of this type to appear in white light.

D.R.Barbe

523.74 : 551.

SOME INDICES OF SOLAR ACTIVITY BASED ON IONOSPHERIC AND RADIO NOISE MEASUREMENTS. See Abstr. 6452.

523.74 : 550.3 : 551.

GEOMAGNETIC, AURORAL, IONOSPHERIC, AND COSMIC RAY PERTURBATIONS: INTERDEPENDENCE AND RELATION TO SOLAR ACTIVITY. See Abstr. 6442-3.

523.7

6590 USE OF THE EQUATION OF HYDROSTATIC EQUILIBRIUM IN DETERMINING THE TEMPERATUR DISTRIBUTION IN THE OUTER SOLAR ATMOSPHERE.

S.R.Pottasch.

Astrophys. J., Vol. 131, No. 1, 68-74 (Jan., 1960).

The temperature distribution from 1.0043 (3000 km) to 20 sola radii in the sun's atmosphere is computed from the observed densit distribution in this region and the assumption of hydrostatic equilibrium. The temperature distribution shows a maximum between 1. and 3 solar radii and a decrease in temperature thereafter. This decrease in temperature is consistent with Chapman's suggestion o thermal conduction only if loss of energy by radiation is included. Inclusion of a radiative energy loss also is shown to invalidated Parker's argument against hydrostatic equilibrium out to large distances from the sun.

523.7

6591 INTERPLANETARY GAS. II. EXPANSION OF A MODE SOLAR CORONA. J.W.Chamberlain.

Astrophys. J., Vol. 131, No. 1, 47-56 (Jan., 1960).

For Pt I, see Abstr. 12944 (1959). The kinetic theory for the escape of planetary and stellar atmospheres, developed by Stoney, Jeans, and others, is generalized to include any height above the atmospheric critical level. The theory is applied to the solar coro and the interplanetary gas; this approach may be contrasted with the use of the hydrodynamic equation of motion and the equations of heat conduction and hydrostatic equilibrium. The hydrodynamic expansion of the corona must actually be limited by the rate of evaporation and large expansion velocities, presumed to correspon to a "solar wind", result from an invalid assignment of an integration constant and an ambiguity inherent in the hydrodynamic solutio Also, the mean energy per particle, which defines an equivalent gas temperature, is considerably lower at the earth's orbit than in the conduction theory, which does not allow for the evaporative escape of the more energetic particles. The mean expansion velocity, electron density, and equivalent temperature computed with the kinetic theory for two extreme situations are plotted against distan from the sun, and limitations to this simple model are discussed.

523.75

6592 ON THE DYNAMICS OF PROMINENCES AND CORONAL CONDENSATIONS. E.Jensen.

Astrophys. Norveg., Vol. 6, No. 9, 93-111 (Sept., 1959).

Various possibilities for the formation of prominences and coronal condensations are discussed. A brief description is given of the general physical properties of the corona and coronal formations. The behaviour of a plasma in a magnetic field having a weak inhomogeneity is analysed. It is shown that when a plasma is not in thermal equilibrium, with $\Delta = E_{\perp} - 2E_{\parallel} \neq 0$, an inhomogeneous magnetic field will have an influence upon the density-distribution in the plasma. When $\Delta > 0$ the plasma behaves like a "diamagnetic" medium, flowing to regions where the magnetic field is smallest. When $\Delta < 0$, the plasma behaves like a "paramagnetic" medium moving towards regions of larger field strength. A non-zero Δ is supposed to be maintained by changes in the magnetic field with time. Depending upon the value of the characteristic scale of the inhomogeneity, the required time-constant for the variations in the field comes out as 30 to 10^4 sec. Consequences of the formation and dynamics of prominences and coronal condensations are briefly discussed.

523.75

6593 CONDENSATION OF PROMINENCES FROM THE CORONA. R.Lüst and H.Zirin.

Z. Astrophys., Vol. 49, No. 1, 8-11 (1960).

The mechanism whereby prominence material condenses out of the overlying coronal gas in a strong magnetic field is treated mathematically; and a formula is derived for computing the theoretical change of temperature caused by compression heating and subsequent rapid cooling by conduction of the coronal matter. This involves a knowledge of the initial temperature T_0 and density n_0 of the gas, and the compression ratio α defined by

$$\alpha = (n_T - n_0)/(T - T_0).$$

Using likely values for the parameters, it is demonstrated that condensation from a hot and dense coronal gas in the vicinity of a strong magnetic field is possible so long as there is a source of initial compression available. The nature of this latter is not known, but it may originate from an intense and variable sunspot magnetic field.

D.R.Barber

523.75

6594 EQUATORIAL CORONAL STREAMERS OF THE SUN. K.Saito.

Publ. Astron. Soc. Japan, Vol. 11, No. 4, 234-52 (1959).

Long equatorial streamers observed on the solar corona pictures of 1955 eclipse were photometrically investigated. Roots of these streamers, five in all, are identified with the green corona sources (neither with filaments nor spots) on the rotation map of the solar phenomena. Brightness distribution tangential to the streamers can be fitted with the error functions. The half-width increases linearly with the solar distances in the regions of the outer corona. Brightness of the streamers along radial direction was investigated and a model is given after comparison with the previous data. Electron density in the streamers is derived as amounting to about 10^7 cm^{-3} at 4 solar radii and 10^3 cm^{-3} at the earth's distance. Number of electrons included in the cross-section 1 cm thick was found to be 1.2×10^{34}. Assuming the equation of continuity, it is concludes that the streamers are accelerated from a nearly zero velocity state to about 500 km at the earth's distance. The result is compared with Parker's theory. Diffusion velocity sideways is estimated as 10 km/sec at most but probably much less in reality. Influence of the streamers on the earth is also discussed.

523.75

6595 THE SOLAR CHROMOSPHERIC OUTBURST OF FEBRUARY 23, 1956. ITS COSMIC AND GEOPHYSICAL EFFECTS. R.Bureau and A.Dauvillier.

J. Phys. Radium, Vol. 18, No. 8-9, 512-17 (Aug. - Sept., 1957). In French.

During this solar cataclysm, first a powerful nocturnal flux of penetrating cosmic rays was observed, whose intensity was of a magnitude never reached during previous observations; then a new phenomenon was observed, consisting of a sudden fade-out on their nocturnal propagation path of tropical atmospherics on the wavelength of 11 km. This is ascribed to this exceptional flux of cosmic rays of solar origin.

523.75

6596 NOTE ON THE EXCITATION OF THE IONIZED HELIUM IN THE SOLAR CHROMOSPHERE. O.Namba.

Publ. Astron. Soc. Japan, Vol. 11, No. 1, 50-3 (1959).

The α-particles carried from the corona by some hypothetical "hot streams" may be a source of the high excitation of the He II spectrum in the low-temperature chromosphere. Significance of the far ultraviolet radiation, also carried by the hot streams, is suggested.

523.75

6597 TEMPERATURE AND TURBULENCE IN QUIESCENT PROMINENCES DERIVED FROM LINE-WIDTHS. P.ten Bruggencate and G.Elste.

Nachr. Akad. Wiss. Göttingen math.-phys. Kl. 2a, No. 9, 255-71 (1959). In German.

Emission lines of H, He, and Ca^+ were observed photographically in 10 quiescent prominences. In the reduction of the spectrograms corrections were applied to eliminate the effects of scattered light in the earth's atmosphere, and in the spectrograph. Profiles of the emission lines were corrected for instrumental broadening, and the half-widths converted to Doppler-widths assuming a Gaussian profile. Kinetic temperatures lying between 5000° K and 11 300° K were deduced, the mean value being ~ 2800° K higher than the excitation temperature. Turbulent velocities of 3.7 to 9.3 km/sec were obtained, the mean value being 5.8 km/sec.

D.R.Barber

523.75

6598 OBSERVATION OF AN ERUPTIVE [SOLAR] PROMINENCE ON TWO SUCCESSIVE DAYS WITH A POLARIZING INTERFERENCE FILTER. W.Comper.

S.B. Österr. Akad. Wiss. mat.-nat. Kl. Abt. II, Vol.167, No. 8-10, 291-302 (1958). In German.

Photograms in Hα light, and isophotal charts of a limb prominence observed at the Kanzelhöhe solar observatory on Sept. 20 and 21, 1955, are reproduced and discussed.

D.R.Barber

523.75

6599 SOLAR FLARES AND SURGES OBSERVED AT THE STOCKHOLM OBSERVATORY AND THE SWEDISH ASTROPHYSICAL STATION IN ANACAPRI IN THE YEAR 1958. Y.Öhman.

Stockholms Obs. Ann., Vol. 20, No. 8, 29 pp. (1959).

Solar flare observations were carried out at Anacapri during 325 days with a total of 2200 patrol hr. In all 483 flares and 160 surges were recorded with the 0.7 A Hα monochromator. At the Stockholm Observatory, in Saltsjöbaden, a Hα monochromator with a passband of only 0.5 A was put into operation at the end of April 1958. Since May 1 a solar patrol has been operating also in Saltsjöbaden, though on a reduced scale. During the eight months from May 1 to December 31, 1958, the number of flares recorded in Saltsjöbaden was 75.

523.75

6600 OBSERVATIONS ON THE GENERAL SOLAR PLASMA INSTABILITY. L.Reiffel.

Phys. Rev. Letters, Vol. 4, No. 3, 136-8 (Feb. 1, 1960).

Qualitative arguments are put forward to show that the onset of instabilities in the solar plasma streams might be detected as an enhancement of electromagnetic emission in the X-ray and low radiofrequency bands. Observations with satellite borne detectors could give useful information if correlated with ionospheric and radio astronomical observations.

H.J.A.Chivers

523.76

6601 CIRCULATION AND MAGNETIC FIELD OF THE SOLAR POLAR ZONE. M.Waldmeier.

Z. Astrophys., Vol. 49, No. 3, 176-85 (1960). In German.

In the N-hemisphere, the polar magnetic field reversed about a year later than in the S-hemisphere, which is due to the spot maximum having occurred about one year later in the northern than in the southern hemisphere. The reversal of the magnetic field takes place when the polar coronal zone reaches the pole, i.e. when the corona shows its typical maximum shape, or when the polar prominence zone is in the latitude of $b = 68^\circ$. As the magnetic measurements refer to the latitude $b = 50^\circ$ to 80°, one can consider the polar prominence zone as the separation between opposite polarities, a conclusion which is supported by the arch-shaped structures of the corona over prominences and by magnetograms from the period when the field reversed. It is found, consequently, that the main prominence zone is another separation between fields of opposite polarities. As the coronal intensity shows minima in the prominence zones, the latter separate the different regions of the coronal emissions. Thus the magnetic zones seem to be closely connected with the coronal emission regions.

523.77

6602 THE EXCITATION OF He I IN THE SOLAR SPECTRUM.
R.G.Athay and H.R.Johnson.

Astrophys. J., Vol. 131, No. 2, 413-28 (March, 1960).

The excitation and ionization of He I in the solar atmosphere is computed for a range of values of n_e and T_e and the radiation field in the resonance lines. Good agreement is found between the observed and computed b_{nls} parameters for $T_e \cong 40\,000^0$-$50\,000^0$ and $n_e \cong 10^{11}$. The criterion for the λ 10830 and λ 5876 lines to show as emission lines against the solar disk is found to be $n_e > \sim 10^{12}$ almost independently of T_e.

523.77

6603 OH IN THE SOLAR SPECTRUM.
C.E.Moore and H.P.Broida.

J. Res. Nat. Bur. Stand, Vol. 63A, No. 3, 279-95 (Nov.-Dec., 1959).

Revised identifications of OH lines in the solar spectrum have been made from the detailed laboratory analyses of the $A\ ^2\Sigma^+ - X\ ^2\Pi$ bands. In the (0,0), (1,1), and (2,2) bands a total of 175 solar lines are ascribed to OH unblended; 124 have OH as a partial contributor. Laboratory intensities along the branches of the separate bands have been used as a guide in making the solar identifications.

523.77

6604 FLASH SPECTRUM BY THE GRAZING INCIDENCE METHOD AT THE TOTAL SOLAR ECLIPSE OF OCTOBER 12, 1958. Z.Suemoto and E.Hiei.

Publ. Astron. Soc. Japan, Vol. 11, No. 2, 122-5 (1959).

At the total solar eclipse of October 12, 1958, in South Pacific a new type of spectrograph was used in order to study both the intensity distributions and the profiles of chromospheric and photospheric lines. This spectrograph is similar to conventional slitless spectrographs normally used for the flash spectrum, but the essential difference is that the grating is used very obliquely. This method was successful in obtaining flash spectra whose line profiles are not affected by the extension of the chromosphere or atmospheric scintillation.

523.77

6605 BALMER SERIES LINES OF THE FLARE AND ITS STRUCTURE. Z.Suemoto and E.Hiei.

Publ. Astron. Soc. Japan, Vol. 11, No. 4, 185-94 (1959).

The line widths of Balmer series lines from H_α to H_{14} were measured on a number of spectrograms of flares of medium importance taken by a wide range spectrograph with the dispersion of 3 A/mm. The width is very wide for the earlier members and decreases to a minimum somewhere around H_9 and then increases slowly to higher members. By assigning the Stark broadening to higher members and the self absorption to lower members the values of the electron density and total number of hydrogen atoms in the second quantum state were derived. On the basis of a uniform model of the flare these two values can only be made compatible when the very small geometical thickness of the order of 10 km is attributed to the whole extension of the flare. It is suggested that the flare is composed of unresolvably fine, presumably thread-like, condensations distributed over the whole extension.

523.77

6606 THE SOURCE FUNCTION IN A NON-EQUILIBRIUM ATMOSPHERE. IV. EVALUATION AND APPLICATION OF THE NET RADIATIVE BRACKET. R.N.Thomas.

Astrophys. J., Vol. 131, No. 2, 429-37 (March, 1960).

For Pt III see Abstr. 11744 (1959). The net rate of a radiative transition between two atomic energy levels depends upon the local radiation field through a factor which is defined as the Net Radiative Bracket (NRB). The results of previous work are applied to show that NRB depends only upon the ratio of radiation absorbed in the line to the local value of the source function in the line and to evaluate this ratio as a function of optical depth in the line. These results may also be applied to the question of the local energy balance in a chromosphere-type atmosphere and to the problem of radiative stability.

523.8

6607 A COSMIC GAS VELOCITY THERMOMETER.
C.E.R.Bruce.

C.R. Acad. Sci. (Paris), Vol. 250, No. 1, 61-3 (Jan. 4, 1960). In French.

The author's electric discharge theory establishes a relation between temperature and gas velocity in stellar and galactic atmospheres. Observational evidence is quoted in support of the theory of temperatures up to $4 \times 10^8\ ^0$K. R.A.Newing

523.8

6608 OBSERVATIONS OF DIRECTIONAL SCINTILLATION.
U.Mayer.

Z. Astrophys., Vol. 49, No. 3, 161-7 (1960). In German.

A harmonic analysis performed on photographic records of image excursion shows an increase of amplitude towards low frequencies down to 0.2 c/s. With increasing zenith distance, the r.m.s. values of the image excursion have the character of a saturation curve. The absence of correlation between image excursion and intensity modulation in stellar scintillation is demonstrated.

523.8 : 539.17

6609 H—He CYCLE IN THE EVOLUTION OF MASSIVE STAR
J.S.Cheng.

Acta phys. Hungar., Vol. 11, No. 2, 117-30 (1960).

In the last evolutionary stage of certain massive stars, there occurs, at a temperature of $4 \times 10^9 - 5 \times 10^9\ ^0$K, a chain of nuclear reactions by means of which He nuclei regenerated by the dissociation of heavier elements are disintegrated into free nucleons. The most probable nuclear reaction chain, as indicated by calculations, is as follows: $He^4(\alpha,p)Li^7$, $Li^7(\alpha,2\alpha)H^3$, $H^3(p,n)He^3$, $He^3(\beta^-)H^3$, $H^3(t,2n)He^4$. The net result of the reaction chain is $He^4(2\beta^-)4n$ with an energy absorption of 29.2 MeV per He nucleus disintegrated. The nuclear process is so rapid at the temperature and density considered that the star undergoes simultaneously a catastrophic collapse and a gigantic explosion during which the nuclear process is completed and the neutrons are expelled and decay spontaneously into protons. The regeneration of hydrogen in the last evolutionary stage of massive stars is regarded as having astrophysical significance. It appears that supernovae are mainly initiated by this process. The abundance of hydrogen in the gases ejected by dense stars the most abundant distribution of hydrogen in the universe among all elements, etc. may be explained on this basis.

523.82

6610 THE IONIZATION AND EXCITATION OF OXYGEN IN THE NEIGHBOURHOOD OF HOT STARS. L.Houziaux.

C.R. Acad. Sci. (Paris), Vol. 249, No. 23, 2497-9 (Dec. 9, 1959). In French.

The relative populations of twelve energy levels of the oxygen atom have been calculated for a point in the envelope of a B2V type star, distant three stellar radii from its centre, at which the electron temperature and density are $10\,000^0$ K and 10^{12} per cm^3 respectively. The method of calculation is however only indicated, no details being given except the results. P.A.Young

523.82

6611 INTERSTELLAR POLARIZATION OF STARLIGHT IN THE NEIGHBOURHOOD OF THE SUN. A.Behr.

Nachr. Akad. Wiss. Göttingen math.-phys. Kl. 2a, No. 7, 185-240 (1959). In German.

A detailed discussion of results obtained from polarization measures of 550 stars within 2000 parsec of the sun. A plot of polarization (expressed in magnitudes) versus distance (in parsec) on a double logarithmic scale gives a linear relationship with a mean slope of 3.10^{-5} mag./parsec. Appended are a rectilinear coordinate chart of measured polarization values for stars out to 1000 parsec, and a bibliography of 58 items. D.R Barber

523.85

6612 THE UNIVERSALITY OF THE INITIAL LUMINOSITY FUNCTION. D.N.Limber.

Astrophys. J., Vol. 131, No. 1, 168-201 (Jan., 1960).

The universality of an initial luminosity function based upon the galastic clusters and the solar vicinity is examined with regard to its implications for the mass-to-light ratios for stellar systems. For this purpose the times that stars spend on and near the main sequence are derived as a function of stellar mass from a discussio of the available data for individual stellar models. These results ar en used to calculate upper limits to the mass-to-light ratios for ellar systems as functions of the ages of the systems — on the ssumption that an initial luminosity function of the usual form has een operative. The observational data relating to the mass-to-light tios for galaxies and globular clusters are then analysed, and the orresponding values for their mass-to-light ratios are obtained. hese observational values are compared with the calculated upper mits, and it is found that ages greatly in excess of 12 billion years ould be required for many galaxies in order for the data to be con-stent with the adopted form of the initial luminosity function. The vidence appears to support strongly the view that the initial lumi-osity function has at times differed in a very significant way from s assumed form. It follows that the form of the initial luminosity nction is sensitive to at least certain of the physical parameters at describe the pre-stellar medium — parameters such as density, mperature, turbulent and magnetic states, and chemical composi-on.

523.85

6613 ON THE ROTATION OF THE INNER PARTS OF THE GALACTIC SYSTEM. G.Münch and L.Münch.

strophys. J., Vol. 131, No. 2, 253-64 (March, 1960).

Results of radial velocity measurements for 18 distant OB tars in galactic longitudes between 345° and 35° are presented. On he basis of published spectroscopic distance moduli, the results ave been interpreted in terms of rotational velocities around the alactic centre and compared with those of the interstellar neutral ydrogen. The stellar motions seem to suggest for the rotational elocity of the galactic system, at a distance of 6 kpc from the entre, a value 10 km/sec higher than that indicated by the 21 cm ne. At a distance of 4 kpc from the centre, the stellar motions rovide rotational velocities around 25 km/sec than the 21 cm line rofiles do. This discrepancy is shown to be unlikely to arise from ystematic errors in the spectroscopic distance moduli or in the adial velocities. The motion of the stars considered indicates a alue of Oort's constant A somewhat larger that the classical value = 20 km/sec. The B0.5 Ia star HD 173438 has been found to be a ingle-line spectroscopic binary with a 250 day period, a semi-mplitude of 50 km/sec, and an eccentricity of 0.54.

523.85

6614 ROTATION AND MASS OF THE LARGE MAGELLANIC CLOUD. D. de Vaucouleurs.

Astrophys. J., Vol. 131, No. 2, 265-81 (March, 1960).

New optical velocities of outlying nebulosities observed with he Mount Stromlo 74 inch reflector are used in conjunction with the old Lick velocities for a rediscussion of the rotation-curve and a revision of the mass estimate previously derived from the Sydney radio observations. If $m_0 - M = 19.0$ and $i = 63^\circ$, the maximum ro-ational velocity is $V_r \cong 145$ km/sec at $r \cong 3.5$ kpc, and the revised mass is $\mathfrak{M} = (2.5 \pm 0.6 \text{ p.e}) \times 10^{10} \odot$; the absorption-free mass-uminosity ratio $\mathfrak{M}/\mathfrak{L}_0$ is about 6, and the ratio of neutral hydrogen o total mass H I/$\mathfrak{M}$ is 4-5%. The evidence for spiral structure in he Large Cloud is reviewed and a possible interpretation for the discrepancy between radio and optical rotation-velocities is out-ined. It appears plausible that the radio estimate of the mass may be too low by a factor ×3 and the optical estimate too high by a factor ×2.

523.85

6615 ON THE DYNAMICS OF GALAXIES WITH LARGE-SCALE MAGNETIC FIELDS. A.Elvius and N.Herlofson.

Astrophys. J., Vol. 131, No. 2, 304-9 (March, 1960).

A new model of a galaxy is described with magnetic lines of orce running parallel to ring structures in the interstellar gas. The influence of the magnetic forces on the motion of the gas clouds is considered, and it is shown that stars born in a gas ring may be ejected from the ring, possibly forming spiral arms.

523.87

6616 PHOTOELECTRIC PHOTOMETRY OF DIFFUSE NEBULAE. D.E.Osterbrock and R.E.Stockhausen.

Astrophys. J., Vol. 131, No. 2, 310-21 (March, 1960).

Measurements are presented of the fluxes in $H\beta$ from two diffuse nebulae, made with interference filters in a photoelectric, photometer attached to a 5-inch F/5 refractor. For one of the nebulae a published radio-frequency observation is also available, and comparison of these two measurements appears to confirm the theory of hydrogen emission, though the accuracy of the measurements is low and the agreement is only just barely within the limits of precision. The Zanstra method is used to calculate the fluxes of ionizing Lyman continuum radiation of the hot stars involved in the nebulae from the $H\beta$ measurements and from published radio-frequency measurements, and these fluxes are compared with the predictions of published model atmospheres. In all cases the deduced far-ultraviolet flux is either equal to or less than the flux expected according to the models; this result can be understood if the ionizing radiation is not completely absorbed in all the nebulae studied. Methods for improving the accuracy of further photoelectric measurements of emission nebulae are given.

523.87

6617 STANDARD STARS FOR PHOTOELECTRIC SPECTROPHOTOMETRY. J.B.Oke.

Astrophy. J., Vol. 131, No. 2, 358-62 (March, 1960).

The energy distribution in the spectra of six early-type stars scattered evenly over all right ascensions have been compared with that of α Lyr between λ 3390 and λ 6000. The measurements were made with a photoelectric spectrum-scanning instrument. The mean errors in the relative monochromatic magnitudes are no more than 0.007 between λ 3900 and λ 5300 and 0.021 elsewhere in the spectrum. These errors are sufficiently small that the stars can be used as standards for any observations of absolute energy distributions.

523.87

6618 A POSSIBLE IDENTIFICATION OF B III IN O-TYPE SPECTRA. A.B.Underhill.

Astrophys. J., Vol. 131, No. 2, 395-8 (March, 1960).

Intensity tracings from high-dispersion spectrograms of the region $\lambda\lambda$ 4460-4560 in the spectra of a Cam, O9.5 Ia; HD 188209, O9.I; 9 Sge, O7 f; HD 192639, O7 f; and λ Cep, O6 f are presented. Short regions near λ 4485 and λ 4503 are noted as being relatively intense. Reasons are given for believing these short sections to be part of the true continuous spectrum. A broad, shallow absorption feature of ill-determined detail appears between these shoulders. The B III lines λ 4487.46 and λ 4497.58 are the most probable origin for this feature on the O7 stars. The remainder of the detail on the intensity tracings can be accounted for by known absorption lines from He I, He II, C III, N III, N IV, O II, O III, O V, Mg II, Al III, and S III.

523.87

6619 SOME NEBULAR SPECTRA OBTAINED WITH THE AID OF THE ELECTRONIC CAMERA.

M.Chopinet and R.Duflot.

C.R. Acad. Sci. (Paris), Vol. 250, No. 10, 1803-4 (March 7, 1960). In French.

An improved form of the Lallemand electronic camera was used in conjunction with the Haute-Provence Observatory's 120 cm telescope and spectrograph from December 1959 to January 1960, to photograph spectra of faint galactic and extra-galactic nebulae. Very satisfactory spectrograms were secured with exposures of from 10 to 30 min., more faint detail being visible than with direct exposures on Eastman 103aF emulsion of from 4 to 5 hours duration. A representative series of spectrograms is reproduced.

D.R.Barber

523.87 : 539.17

6620 THE TEMPERATURE REQUIRED FOR NUCLEAR REACTIONS IN COSMICAL ELECTRICAL DISCHARGES.

C.E.R.Bruce.

Nature (London), Vol. 184, 2004-5 (Dec. 26, 1959).

On the assumption that the emission lines in the spectra of some extra-galactic nebulae are due to electrical discharges it is shown that there is good agreement between the calculated and observed gas velocities if it is assumed that the temperature in the cosmic gas is between 10^9 and 10^{10} deg K. It is suggested that this temperature is limited only by the temperature at which nuclear processes will occur in the gas and hence that nuclear processes occur freely in cosmical atmospheres at a temperature of about 400×10^6 deg. K.

C.Hazard

523.877

6621 SPECTROSCOPIC PROBLEMS OF STELLAR EVOLUTION. A.Unsöld.

Naturwissenschaften, Vol. 47, No. 4, 73-80 (1960). In German.

In this review of recent developments in observational cosmology, the formation of heavy elements, stellar populations and evolution in galaxies, and evolution processes in stars are discussed with special reference to estimates of the time scale of the universe and the hypothesis of continuous development from an initial state of pure hydrogen. The importance of quantitative spectral analysis of stars of different populations is emphasized. R.A.Newing

523.877

6622 A MAGNETOSTATIC MODEL FOR A COMPRESSIBLE STAR. L.Woltjer.

Astrophys. J., Vol. 131, No. 1, 227-30 (Jan., 1960).

A magnetostatic model for a compressible star is obtained, by means of a perturbation procedure, under the assumption that the magnetic field is not too strong. The results show that the density gradient causes the magnetic energy density to be somewhat more concentrated toward the centre than in the incompressible counterpart part of this model, which was obtained by Prendergast, but the difference is small.

523.877

6623 MOLECULES AND LATE-TYPE STELLAR MODELS. M.S.Vardya and R.Wildt.

Astrophys. J., Vol. 131, No. 2, 448-51 (March, 1960).

A difficulty encountered by Osterbrock, when he tried to identify particular red dwarf stars by interpolating between his models of late-type main-sequence stars, is shown to be alleviated by including the effects produced by hydrogen molecules in the convective zone.

523.877

6624 A PERTURBATION METHOD IN THE THEORY OF STELLAR STRUCTURE. Su-Shu Huang.

Astrophys. J., Vol. 131, No. 2, 452-8 (March, 1960).

A method for calculating the perturbations of the eigenvalues appearing in the theory of stellar structure is developed. This method has been applied to the stellar model consisting of a radiative envelope over a convective core, and the perturbation due to a change in the exponent in the modified form of Kramer's law of opacity has been calculated.

523.877

6625 QUICK METHOD OF DETERMINING THE CENTRAL TEMPERATURES OF STARS. J.S.Cheng.

Acta phys. Hungar., Vol. 11, No. 1, 91-4 (1960).

The method depends on a numerical coincidence between the mean gravitational pressure and the central radiation pressure and is not applicable to degenerate stars or (possibly) to stars of very low density. G.A.Chisnall

525

6626 ON THE ACCELERATION OF THE EARTH'S ROTATION CAUSED BY THE ATMOSPHERIC OSCILLATION.

N.Sekiguchi.

Publ. Astron. Soc. Japan, Vol. 11, No. 1, 1-8 (1959).

The rate of increment of the earth's rotational energy caused by the atmospheric oscillation was determined as 2.06×10^{18} erg/sec, using the same data used by Holmberg, from which it can hardly be concluded that the acceleration of the earth's rotational velocity compensates its deceleration caused by the tidal friction.

525

6627 THE GRAVITATIONAL FIELD OF THE EARTH. J.A.O'Keefe, A.Eckels and R.K.Squires.

Astron. J., Vol. 64, No. 7, 245-53 (Sept., 1959).

The theory of the orbit of the Vanguard satellite is developed using as arbitrary constants the six initial orbital elements, the zonal spherical harmonics of the earth's field of degrees 0, 2, 3, 4, and a table of observed values of the mean anomaly at the epoch. Comparison is made with the elements calculated by the Vanguard computing centre; it is shown that most of the changes in the elements are reproduced in this way.

525

6628 FORMULAE FOR PREDICTING THE POSITION OF AN ARTIFICIAL SATELLITE. B.Garfinkel.

Astron. J., Vol. 64, No. 7, 270-2 (Sept., 1959).

525

6629 THE ORBIT OF A SATELLITE OF AN OBLATE PLANET. B.Garfinkel.

Astron. J., Vol. 64, No. 9, 353-66 (Nov., 1959).

The paper gives a solution of the problem of motion of a partic in the potential field $V = -I/r + 2kP_2(\sin\theta)/r^3 + k'P_4(\sin\theta)/r^5$, where k and k' are small parameters. The first approximation is furnished by a V_0 that incorporates a major portion of the second spherical harmonic and leads to a closed solution with no secular variations of order k. The perturbations of this non-Keplerian inte mediary orbit are derived here by the von-Zeipel modification of th method of Delaunay. The secular variations are carried up to orde k^2 and k', and the periodic variations to orders k and k'/k. A computational summary is included; the effect of the third spherical harmonic is appended.

52

6630 THE MOTION OF A CLOSE EARTH SATELLITE. Y.Kozai.

Astron. J., Vol. 64, No. 9, 367-77 (Nov., 1959).

In the present paper perturbations of six orbital elements of a close earth satellite moving in the gravitational field of the earth without air-resistance are derived as functions of mean orbital elements and time. No assumptions are made about the order of magnitude of eccentricity and inclination. However, it is assumed that the density distribution of the earth is symmetrical with respect to the axis of rotation, that the coefficient of the second harmonic of the potential is a small quantity of the first order and that those of the third and the fourth harmonics are of the second order. The results include periodic perturbations of the first order and secular perturbations up to the second order. However, the solutions have some singularities for an orbit whose eccentricity or inclination is smaller than a quantity of the first order, and this case is treated in a different way. By using Delaunay's canonical elements a theorem is proved that there are no long-periodic terms of the first order in the expression of the semi-major axis.

52

6631 NOTE ON THE MOTION OF A CLOSE EARTH SATELLI Y.Kozai.

Publ. Astron.Soc. Japan, Vol. 11, No. 2, 121 (1959).

Certain equations derived in a previous paper (Abstr. 5340 of 1959) are corrected, due to a mistake in the developement of the Hamiltonian of the motion.

52

6632 SOLUTION OF THE PROBLEM OF ARTIFICIAL SATELLITE THEORY WITHOUT DRAG. D.Brouwer.

Astron. J., Vol. 64, No. 9, 378-97 (Nov., 1959).

Sections 1-6 give the solution of the main problem for a spheroidal earth with the potential limited to the principal term and the second harmonic which contains the small factor k_2 The solutic is developed in powers of k_2 in canonical variables by a method whic is bascially the same as that used in treating a different problem by von Zeipel (1916). The period terms are divided in two classes: the short-period terms contain the mean anomaly in their argument the arguments of the long-period terms are multiples of the mean argument of the perigee. The periodic terms, both of short and long period, are developed to $O(k_2)$; the secular motions are obtaine to $O(k_2^2)$. The results are obtained in closed form; no series developments in eccentricity or inclination arise. The solution does not apply to orbits near the critical inclination, 63°.4, but is otherwise valid for any eccentricity < 1 and any inclination. Section 7 gives the long-period terms and the additions to the secular motions caus by the fourth harmonic in the potential; section 8 gives the contributions by the third and fifth harmonics; section 9 contains formulae for computation.

525 : 551.

6633 SATELLITE DOPPLER MEASUREMENTS AND THE IONOSPHERE. J.A.Thomas and F.H.Hibberd.

J. atmos. terrest. Phys., Vol. 13, No. 3-4, 376-9 (Feb., 1959).

52

6634 ORBIT TO THE SUN. E.Feenberg.

Amer. J. Phys., Vol. 28, No. 5, 497-8 (May, 1960).

The problem of dropping a projectile into the sun is considere from the point of view of minimizing the rocket capability required to convert from a nearly circular orbit (essentially the orbit of the earth) to a nearly radial orbit.

529

6635 AN IMPROVED CAESIUM FREQUENCY AND TIME STANDARD. L.Essen and J.V.L.Parry.

Nature (London), Vol. 184, 1791 (Dec. 5, 1959).

See Abstr. 9509 (1957). A resonance curve of only 52 c/s half-width has now been obtained, and the practicability of a standard of time with a precision of a few parts in 10^{11} is indicated. The numerical value of the resonance, 9 192 631 804 c/s, agrees within experimental error with that already adopted, viz: 9 192 631 770 c/s.

P.A.Young

PHYSICS

GENERAL

53

6636 SECONDARY SCHOOL PHYSICS: THE PHYSICAL SCIENCE STUDY COMMITTEE. G.C.Finlay.

Amer. J. Phys., Vol. 28, No. 3, 286-93 (March, 1960).

The physics course developed by the Physical Science Study Committee is outlined in some detail. Examples of the laboratory work and of the instructional films that accompany the course are included to show how these parts of the course are integrated with the text on the one hand and supplementary to it on the other.

53

6637 MORE EFFECTIVE TEACHING OF PHYSICS THROUGH TELEVISION. H.E.White.

Amer. J. Phys., Vol. 28, No. 4, 368-74 (April, 1960).

The teaching of introductory physics courses to large groups of students was conducted in the past by the use of large lecture halls. Problems that arise in such situations are numerous, some of the major ones being (1) making equipment large enough to be seen by everyone, (2) finding storage space for much large equipment, (3) keeping the lecture hall free of students for one whole period to provide ample time for setting up demonstrations, etc. Methods for solving these problems are presented here. By building three lecture room fronts on a single turntable, two complete lecture periods become available for setup time. Roll-in tables are not satisfactory. By using TV cameras with TV monitors suspended from the ceiling, demonstrations can be made clearly visible to everyone. An alternative solution, and in many respects the best one, is to develop several TV studio areas, use TV methods entirely, and by closed circuit transmission to monitors in small classrooms, reach students in groups of twenty-five or thirty. A teaching assistant in each of these rooms is then available for more intimate discussions.

53

6638 ON TEACHING THE PHILOSOPHY OF PHYSICS. R.J.Seeger.

Amer. J. Phys., Vol. 28, No. 4, 384-93 (April, 1960).

Starting from the thesis that the philosophy of physics is taught in all courses of physics, including college general physics, the author urges teachers to become more articulate in their expressions in view of the ideological inferences being drawn by certain national groups. He illustrates his concern with three examples of modern physics, namely, relativity theory, concept of mass, and quantum mechanics. In each case he notes the Soviet interpretations, particularly as expounded by A.F.Ioffe in his book "Basic Concepts in Contemporary Physics".

53

6639 CREATIVE THINKING AND EXPERIMENTING. H.R.Crane.

Amer. J. Phys., Vol. 28, No. 5, 437-43 (May, 1960).

The assumption is made that creative thinking, like playing tennis or bridge, is an activity rather than a phenomenon; that it can be cultivated through coaching and practice. An individual's ability at creative thought is not fixed in the same sense that the size of his feet are fixed. Therefore, the method which is often used for fostering it in the schools, namely, sorting out the creative thinkers and giving them special opportunities, meets only a part of the problem. A discussion of the creative process is given, with examples from the writings of Poincaré and others, followed by some words of advice which can be passed on to students. Experimental science projects are discussed, with particular reference to those which are entered in science fairs. A sharp distinction is drawn between projects which are scientific investigations and those which are demonstrations. The former follows the pattern of question, hypothesis, experiment, modified hypothesis, etc. More new questions are raised than are answered, and the true flavour of research is tasted. The project which merely demonstrates a scientific process or principle may be a good teacher of facts, but it does not provide the experience of finding an answer by the scientific method. Some examples of the two types of projects are described.

53

6640 ANNIVERSARIES IN 1960 OF INTEREST TO PHYSICISTS. E.S.Barr.

Amer. J. Phys., Vol. 28, No. 5, 462-75 (May, 1960).

During the year 1960 there will be major anniversaries of the birth or death of one woman and seven men who have figured importantly in the development of physics. Brief accounts of their lives and contributions are presented here.

53

6641 GRAVITATIONAL AND INERTIAL MASS. G.B.Brown.

Amer. J. Phys., Vol. 28, No. 5, 475-83 (May, 1960).

One of the most astonishing features of the history of physics is the confusion which surrounds the definition of the key term in dynamics — mass, a confusion which has existed almost from the day that Newton defined it. Originally defined as a measure, i.e., a number, it became something which a body had, which could be measured. Mach considered the definition "unfortunate", Einstein "illusory", and Sommerfeld called it a "mock definition". Yet without it Newton could not have laid the foundations of dynamics, succeeding where Galileo failed. A careful examination of the problem shows, with very little doubt, that when Newton used the word density he meant what we now call relative density. His definition of mass is then unexceptionable. What is unfortunate is that he allowed himself to speak of mass with the common meaning as well as with the special meaning he had given it. Recently the terms gravitational and inertial mass have been coming into greater use, but the confusion has increased rather than diminished. The author's theory of inertia, which is in quantitative agreement with experiment, helps to lessen the confusion, both old and new.

53

6642 A CERTAIN BOUNDARY VALUE PROBLEM AND ITS APPLICATIONS. O.P.Bhutani.

Appl. sci. Res. A, Vol. 8, No. 6, 413-24 (1959).

A linear second-order partial differential system arising in mathematical physics is solved with the help of Laplace transforms, involving more general boundary conditions, in terms of Mathieu functions. Four physical problems are presented: natural convection inside a vertical tube; onset of viscous flow in an elliptic pipe; eddy current losses in solenoids; heat production in a cylinder. It is indicated that their solutions can be deduced as a particular case.

53

6643 MATTER AND POINT SET THEORY. A.Kyrala.

Phys. Rev., Vol. 117, No. 5, 1409 (March 1, 1960).

A brief theoretical exposition of the concept of matter as a nowhere dense perfect set of positive measure is developed starting from the observation that matter is largely vacuous in all scales from subnuclear to extragalactic.

53 : 621.383.2.032.35

6644 AN ELECTROLUMINESCENT DIGITAL INDICATOR WITH A SILICON CARBIDE CODING MATRIX. D.H.Mash.

J. sci. Instrum., Vol. 37, No. 2, 47-50 (Feb., 1960).

A digital indicator is described using an electroluminescent panel having its back electrode shaped as an array of lines, from combinations of which the digits are formed. Also describes is a coding matrix which greatly simplifies the electrical switching needed for the indicator. The coding matrix utilizes the non-linear electrical properties of silicon carbide powder to discriminate between the voltage applied to wanted elements and unwanted elements, and allows a single-pole ten-way switch to be used for selecting the required digit.

GRAVITATION . RELATIVITY

530.12 : 532.5

6645 A RELATIVISTIC ANALOGUE OF A SIMPLE NEWTONIAN RESULT. S.R.Roy.
Proc. Nat. Inst. Sci. India A, Vol. 23, No. 4, 241-5 (1957).

A liquid sphere of radius R is considered with a density α for $0 < r < r_0$ and a density β for $r_0 < r < R$. The relativistic relation defining the mass m in terms of α, β, r_0 and R is obtained, in an approximate form.

530.12

6646 SUPER-ENERGY TENSOR AND IRREDUCIBLE COMPONENTS OF THE RIEMANN TENSOR. R.Debever.
C.R. Acad. Sci. (Paris), Vol. 250, No. 1, 64-6 (Jan. 4, 1960).
In French.

The author's symmetrized form of Bel's tensor is expressed in terms of the irreducible components of the Riemann tensor and an application is made to the case of a vacuum electromagnetic field.
R.A.Newing

530.12

6647 INTEGRATION OF THE EQUATIONS OF MOTION OF THE NAKANO ROTATOR. F.Halbwachs.
C.R. Acad. Sci. (Paris), Vol. 249, No. 23, 2500-2 (Dec. 9, 1959).
In French.

530.12

6648 ASYMMETRIC METRIC AND REPRESENTATION OF CHANGES IN LOCAL AXES. APPLICATION TO THE THEORY OF THE GRAVITATIONAL EFFECT OF SPIN.
O.Costa de Beauregard.
C.R. Acad. Sci. (Paris), Vol. 250, No. 6, 984-6 (Feb. 8, 1960).
In French.

The transformation from a Riemannian space defined by the metric $g^{\underline{\mu\nu}}$ to one defined by $g_{\underline{\mu\nu}}$ is interpreted as a change in local axes, the $g^{\overset{\vee}{\mu\nu}}$ or $g_{\overset{\vee}{\mu\nu}}$ defining infinitesimal rotations. A brief criticism is made of Sciama's non-symmetric theory of the gravitational field.
R.A.Newing

530.12

6649 COMPARISON OF DIFFERENT COORDINATE CONDITIONS IN EINSTEIN'S GRAVITATION THEORY.
V.A.Fok.[Fock]
Zh. eksper. teor. Fiz., Vol. 38, No. 1, 108-15 (Jan., 1960). In Russian.

It is shown that the first-approximation coordinate conditions actually used by Eistein and Infeld in the problem of mass motion coincide with the harmonic ones and determine the coordinate system in the first approximation apart from a Lorentz transformation. The difference between the Einstein—Infeld coordinate system and the harmonic one is given by the order of smallness of admissible non--Lorentz transformations. These differences can be found in an explicit form. They are so small that they cannot influence the form of the equations of motion in the first post-Newtonian approximation. On the basis of the results obtained the fundamental approach of Einstein and Infeld to the coordinate problem is criticized.

530.12

6650 A PARTICULAR SOLUTION OF THE FIELD EQUATIONS IN EINSTEIN'S GENERALIZED THEORY OF GRAVITATION. R.Tiwari.
Proc. Nat. Inst. Sci. India A, Vol. 23, No. 4, 293-305 (1957).

A particular solution of the gravitational field equations in Einstein's generalized theory of gravitation has been obtained. The field set up is such that it reduces to the field of a point mass in classical relativity in the absence of the electromagnetic field, and also up to the first order of approximations it reduces to the field of uniform monochromatic radiation ($E_y = H_z = -A \cos 2\pi(x-t)/\lambda$, $E_x = E_z = H_x = H_y = 0$) in the absence of the point mass. The charge density and the first component of the current vector density vanish all along the x-axis while the remaining components of the current vector density vanish on the positive side of this axis and become infinite on its negative side. The electric and magnetic intensities are affected by the presence of the gravitational field of the point mass. The electromagnetic field possesses the properties of a plane wave. There are four partial differential equations of the second order for the four electromagnetic vector potentials subject to the condition of continuity. When the values obtained for the electromagnetic field quantities are substituted in the ten gravitational equations they are reduced to those of general relativity for a weak field. The solution obtained contains a line of singularities. It is noted that this solution is a transform of the Schwarzchild solution through a singular transformation.

530.12

6651 REMARKS ON THE FUNCTIONAL INTEGRATION QUANTIZATION OF GRAVITATION. B.E.Laurent.
Ark. Fys., Vol. 16, Paper 26, 279-83 (1959).

The use of the Feynman method for the quantization of generally covariant systems, with special attention to Feynman quantization of general relativity is discussed. The problem of the choice of the domain for the functional integration remains. T.R.Carson

530.12

6652 A VARIATIONAL PRINCIPLE AND CONSERVATION THEOREMS IN CONNECTION WITH THE GENERALLY RELATIVISTIC DIRAC EQUATION. B.E.Laurent.
Ark. Fys., Vol. 16, Paper 25, 263-78 (1959).

Klein's treatment of the gravitational field, based on the use of the γ and Γ matrices from the Bargmann theory of the generally covariant Dirac thery, is extended to a gravitational field interacting with a Dirac field. An action integral, containing these matrices, is introduced and the two sets are varied independently. The new equations are compared with those of Einstein and Dirac. T.R.Carson

530.12

6653 GRAVITATION IN A NONLINEAR MICROPHYSICAL THEORY. J.L.Destouches.
J. Phys. Radium, Vol. 18, No. 11, 642-3 (Nov., 1957). In French.

Suggests a theory of gravitation and electromagnetism, based on a particle of maximum spin 2. See also Abstr. 864 (1958).
R.J.N.Phillips

530.12

6654 THE POSSIBILITY OF MEASURING THE PROPAGATIO VELOCITY OF GRAVITATION UNDER LABORATORY CONDITIONS. I.L.Berstein and M.E.Gertsenstein.
Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1832-3 (Dec., 1959). In Russian.

An experiment to measure the velocity of gravitational waves is proposed and discussed. The apparatus would consist of two mechanical oscillator devices placed at different distances from a rotating wheel which carries on its rim a number of heavy balls. Measurements of the phase difference in the oscillations would be made by advanced radiotechnical methods. P.Roman

530.1

6655 DETECTION AND GENERATION OF GRAVITATIONAL WAVES. J.Weber.
Phys. Rev., Vol. 117, No. 1, 306-13 (Jan. 1, 1960).

Methods are proposed for measurement of the Riemann tensor and detection of gravitational waves. These make use of the fact that relative motion of mass points, or strains in a crystal, can be produced by second derivatives of the gravitational fields. The strains in a crystal may result in electric polarization in consequence of the piezoelectric effect. Measurement of voltages then enables certain components of the Riemann tensor to be determined. Mathematical analysis of the limitations is given. Arrangements are presented for search for gravitational radiation. The generatio of gravitational waves in the laboratory is discussed. New methods are proposed which employ electrically induced stresses in crystal These give approximately a seventeen-order increase in radiation over a spinning rod of the same length as the crystal. At the same frequency the crystal gives radiation which is about thirty-nine orders greater than that of a spinning rod.

530.12 : 538.5

6656 A NEW EXPERIMENTAL TEST OF SPECIAL RELATIVITY. J.P.Cedarholm and C.H.Townes.
Nature (London), Vol. 184, 1350-1 (Oct. 31, 1959).

The experiment compares the frequencies of two maser oscilla-ors with their beams of ammonia molecules pointed in opposite directions, but both parallel to a supposed direction of motion through the ether. If both masers are rotated 180°, and their frequencies again compared, a change in relative frequency should be found due to motion of the masers through the ether, assuming the molecular motions are unchanged by such motion. A precision of one part in 10^{12} has been achieved in this frequency comparison, and failure to find a frequency change of the predicted type allows setting the upper limit on an ether drift as low as 10^{-3} of the orbital velocity of the earth. This is about $\frac{1}{40}$ the limit set by any previous experiment. The experiments have the advantage that the expected effect is linear in the drift velocity, and also that two clocks can now be compared with much greater precision than two distances. It is shown that it is not possible to account for this null result in terms of the Fitzgerald contraction theory. The experiment was repeated for a year at three-monthly intervals to avoid the possibility of the drift velocity being accidentally zero at the time of one of the experiments. Further possible deductions from this experiment or more precise experiments which might be performed with optical masers are discussed. J.M.Baker

530.12

6657 DOES A PSEUDOSPINOR EXIST?
Yu.M.Lomsadze.

Bul. Inst. Politeh. Iasi, Vol. 3(VII), No. 3-4, 61-4 (1957). In Russian.

Critical remarks on the usage of the term "pseudospinor". [These questions have been fully discussed elsewhere, e.g. Abstr. 3481 (1950). The last section of the present paper is erroneous]. P.Roman

530.12

6658 RELATIVISTIC REACTION SYSTEMS AND THE ASYMMETRY OF TIME SCALES. K.L.Kowalski.

Amer. J. Phys., Vol. 28, No. 5, 487-91 (May, 1960).

As a simple illustration of the asymmetry of time scales between inertial and noninertial reference frames, a specific accelerated trajectory of a reaction system is calculated. A time dilatation resulting from the asymmetry is found to exist and to arise from contributions of the accelerated and constant velocity portions of the trajectory.

530.12 : 512.9

A COMPLEX NON-ANALYTICAL MANIFOLD AND CONFORMAL MINKOWSKI SPACE–TIME. See Abstr. 6536

530.12

6659 ON THE EQUATIONS OF MOTION IN GENERAL RELATIVITY. Pham Tan Hoang,

C.R. Acad. Sci. (Paris), Vol. 250, No. 7, 1195-7 (Feb. 15, 1960). In French.

The geodesic equation is applied to the problem of the motion of point masses in the approximation of weak field and small velocities. In the case of only two bodies the classical result is recovered. T.R.Carson

530.12

6660 CANONICAL VARIABLES FOR GENERAL RELATIVITY.
R.Arnowitt, S.Deser and C.W.Misner.

Phys. Rev., Vol. 117, No. 6, 1595-1602 (March 15, 1960).

The general theory of relativity is cast into normal Hamiltonian form in terms of two pairs of independent conjugate field variables. These variables are explicitly exhibited and obey ordinary Poisson bracket relations. This form is reached by imposing a simple set of coordinate conditions. It is shown that those functionals of the metric used as invariant coordinates do not appear explicitly in the Hamiltonian and momentum densities, so that the standard differential conservation laws hold. The bearing of these results on the quantization problem is discussed.

530.12

6661 POYNTING VECTOR IN GENERAL RELATIVITY.
Le-Thanh-Phong.

C.R. Acad. Sci. (Paris), Vol. 250, No. 6, 987-9 (Feb. 8, 1960). In French.

The compatibility of the work of Bel and of Pirani on gravitational radiation is explained by showing that the Poynting vectors derived respectively from Bel's analogue of the Maxwell tensor (Abstr. 1020 of 1959) and Pirani's covariant approximation to the energy-momentum pseudo-tensor (Abstr. 3944 of 1957) are the same. R.A.Newing

530.12

6662 THE GENERAL FOKKER ACTION PRINCIPLE AND ITS APPLICATION IN GENERAL RELATIVITY THEORY.
J.Plebański and S.Bażański.

Acta. phys. Polon., Vol. 18, No. 4, 307-45 (1959).

A method of constructing a Fokker action principle (a principle in which only the dynamical variables appear) for the equations of motion of dynamical systems is given. This method is used to find the action principle leading to the post-Newtonian equations of motion of a perfect fluid in general relativity theory. The Lagrange function appearing in this principle is discussed for the case of the motion of a fluid concentrated into drops. The group of isolated drops of the perfect fluid was introduced as a model describing the motion of the system of bodies in general relativity theory. The behaviour of the Lagrangian as the drop dimensions tend to zero is investigated and the renormalization of the equations of motion of point singularities in general relativity theory is discussed. The calculations for finding the equations of motion in general relativity theory by this method are much simpler than those by previously known methods.

530.12

6663 POSSIBLE NEW EXPERIMENTAL TEST OF GENERAL RELATIVITY THEORY. L.I.Schiff.

Phys. Rev. Letters, Vol. 4, No. 5, 215-17 (March 1, 1960).

It is emphasized that, in order to test the full structure of the general theory, it is necessary to design experiments which do not depend exclusively upon the equivalence principle and the special theory. A possible test might be provided by a spinning test particle (a torque-free gyroscope) which would act as a clock whose frequency would exhibit the Doppler and gravitational shifts. A further test would be provided by observations of the precession of the spin axis in the case of a gyroscope mounted either in a satellite, or in an earth-bound laboratory. R.A.Newing

530.12

6664 A DIRECT CONSEQUENCE ARISING FROM THE RELATIVISTIC HANDLING OF AN "UNIFORM" FIELD.
I.Gottlieb.

Nuovo Cimento, Vol. 14, No. 5, 1166-70 (Dec. 1, 1959).

The metric $ds^2 = c^2(1 - kx)dt^2 - (1 - kx)^{-1}dx^2 - dy^2 - dz^2$ is taken as the relativistic analogue of a Newtonian uniform field and the 3-space trajectories of a test particle are shown to be parabolic arcs. The motion of a charged particle in a uniform field is discussed for the case $kx \ll 1$. R.A.Newing

530.12

6665 THE CONCEPT OF A RIGID MOTION [IN RELATIVITY].
C.B.Rayner.

R.C. Accad. Naz. Lincei, Vol. 26, No. 4, 478-83 (April, 1959). In French.

For a positive definite metric, the distance of a point P of the curve Λ_P from the curve Λ_Q through Q is defined to be the lower limit of the lengths of all curves joining P to points of Λ_Q. A rigid congruence is such that this distance is independent of the position of P on Λ_P. The definition is extended to include the case of a hyperbolic metric. R.A.Newing

530.12

6666 GENERAL COVARIANT METHOD OF SUCCESSIVE APPROXIMATIONS IN THE GENERAL THEORY OF RELATIVITY. I.I.Gutman.

Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1639-45 (Dec., 1959). In Russian.

A new approach to the mathematical problem of gravitational theory is proposed which always ensures the uniqueness of the solution without the necessity of invoking auxiliary coordinate conditions. For solution of this problem a general covariant method of successive approximations is developed in which the quantity γ/c^2 (where γ is Newton's constant) is taken as the small parameter of the expansion. It is shown that in all approximations the equations of successive approximations have the same form as the general covariant D'Alembert equation with a right-hand side. An energy-momentum tensor of the gravitational field (which is separated from the inertial force field) is introduced, this tensor satisfying the law of conservation in inertial systems. In distinction to the Einstein–Infeld–Hoffman and Fock methods the method proposed here is applicable to any rapidly varying fields and to arbitrary velocities including those approaching the velocity of light.

530.12

6667 **EQUATIONS OF STEPHENSON AND SPHERICAL SYMMETRY.** S.N.Pandey.
Curr. Sci., Vol. 28, No. 11, 442 (Nov., 1959).

It is shown that Schwarschild's exterior solution of Einstein's equations is the only spherically symmetric solution of the equations of Stephenson. It follows that the latter therefore do not describe any new gravitational situation so far as spherical symmetry is concerned. T.R.Carson

530.12

6668 **MOTION OF A FREE PHOTON IN A GRAVITATIONAL FIELD.** C.Cattaneo.
R.C. Accad. Naz. Lincei, Vol. 27, No. 1-2, 54-9 (July-Aug., 1959). In Italian.

The definition of "standard" quantities relative to a frame of reference (Abstr. 9190 of 1959) is extended to the case of a photon. Frequency variation in a gravitational field appears as a consequence of the conservation of the "total relative energy" of the photon. R.A.Newing

530.12

6669 **A RADIATING MASS PARTICLE IN AN EXPANDING UNIVERSE.** P.C.Vaidya and K.B.Shah.
Proc. Nat. Inst. Sci. India A, Vol. 23, No. 6, 534-9 (1957).

The McVittie problem of a mass particle in an expanding universe is solved in the case when the mass particle is a source of radiation.

530.12

6670 **RELATIVISTIC THEORY OF THE BEHAVIOR OF CLOCKS.** T.C.Bradbury.
Amer. J. Phys., Vol. 28, No. 5, 443-6 (May, 1960).

The clock paradox is studied both from the point of view of special and general relativity. A solution for the case of a space ship moving in a straight line path with arbitrary acceleration is given in terms of special relativity. It is pointed out that an appeal to general relativity is not necessary as long as a single clock in the accelerator frame is considered, but that general relativistic considerations are necessary if two clocks separated by an appreciable distance are introduced into the accelerated frame. A solution for this case is given.

530.12

6671 **ON A SOLUTION OF FIELD EQUATIONS IN EINSTEIN'S UNIFIED FIELD THEORY II.** N.N.Ghosh.
Progr. theor. Phys., Vol. 17, No. 2, 131-8 (Feb., 1957).

For Pt I see Abstr. 6859 (1957). Some observations are made regarding a type of non-static solution of Einstein's field equations in "strong" form. Denoting the coordinates by x_k, x_m, x_n, x_l a static field $g_{\mu\nu}$ with components involving the coordinate x_k is made non-static by changing x_k into $x_k + \epsilon x_l$ where ϵ is a constant. For the spherically symmetric case it is found that such a solution of field equations is generally transformable into Bonnor's solution for the static field. When, however, the field components are all functions of $(x_k + \epsilon_{x_l})$ only and the field is not spherically symmetric a non-trivial solution is obtained.

530.12

6672 **ON THE SPHERICALLY SYMMETRIC SOLUTIONS OF THE UNIFIED FIELD THEORY.** M.Lenoir.
C.R. Acad. Sci. (Paris), Vol. 250, No. 6, 981-3 (Feb. 8, 1960). In French.

The solutions of Papapetrou and of Bonnor are here derived by a variational method. R.A.Newing

530.12

6673 **THE TOTAL RADIATION IN EINSTEIN'S UNIFIED FIELD THEORY.** S.I.Husain.
C.R. Acad. Sci. (Paris), Vol. 250, No. 3, 466-7 (Jan. 18, 1960). In French.

Assuming that the total radiation energy in a unified field theory is characterized by the curvature tensor, discontinuities in the latter will occur at the wave front. The ray property of the propagation is demonstrated. T.R.Carson

530.12

6674 **CONDITIONS OF INTEGRABILITY AND THE MOTION OF A PARTICLE IN EINSTEIN'S LATEST UNIFIED THEORY.** E.Clauser.
R.C. Accad. Naz. Lincei, Vol. 26, No. 4, 498-505 (April, 1959). In Italian.

An extension of the Einstein—Infeld—Hoffman method to the field equations of the 1953 unified field theory. R.A.Newin

530.12

6675 **MOTION OF ELECTRIC DIPOLES IN EINSTEIN'S LATEST UNIFIED THEORY.** C.Venini.
R.C. Accad. Naz. Lincei, Vol. 26, No. 4, 490-7 (April, 1959). In Italian.

Clauser's method involving biharmonic electrostatic potentials (Abstr. 3691 of 1958) is used to obtain a first approximation to the equations of motion of a charged dipole in the field of a similar particle. R.A.Newing

530.12 : 538.56

6676 **PROPAGATION OF A STRONG ELECTROMAGNETIC—GRAVITATIONAL WAVE IN VACUUM.** A.S.Kompaneyet
Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1722-6 (Dec., 1959). In Russian.

It is shown that a strong electromagnetic—gravitational wave possesses a system of rectilinear and parallel characteristics and hence the velocity of propagation of any small additional perturbation will always be equal to that of light. It therefore cannot be expected that there exist solutions with an Euclidean metric at infinity which are qualitatively different from the ordinary electromagnetic waves in finite spatial regions.

530.12

6677 **ON [THE DERIVATION OF] THE EQUATIONS OF MOTION IN THE JORDAN—THIRY THEORY BY THE METHOD OF THE ENERGY-MOMENTUM TENSOR.** A.Surin.
C. R. Acad. Sci. (Paris), Vol. 250, No. 10, 1805-7 (March 7, 1960). In French.

The equations are derived in the first approximation for a field with N interior domains, and are shown to be consistent with those previously derived for N charged point masses by the method of singularities. R.A.Newing

QUANTUM THEORY

(Applications of quantum theory to elementary particles and nuclei are included under Nuclear Field Theory)

530.14

6678 **EQUATIONS FOR A MIXED TENSOR FIELD.** B.E.Laurent.
Ark. Fys., Vol. 16, Paper 24, 247-61 (1959).

In connection with a generally invariant quantum theory, such a that of Klein, involving a mixed tensor density of weight one half, the question arises if there is a way of writing covariant equations, similar to Einstein's equations: without involving the metric field. The curvature tensor is written in terms of the affine connection in the usual way but the affine connection is expressed in terms of the mixed tensor density of weight one half, C^{μ}_{ν}, and its derivatives instead of the metric tensor $g_{\mu\nu}$ and its derivatives. The affinity is now obtained from the relations $C^{\mu}_{\nu;k} = 0$ which replace the relation $g_{\mu\nu;k} = 0$ in the metric case. T.R.Carson

530.14

6679 **ON THE INTEGRALS OF MOTION OF THE GENERALIZED DIRAC-EQUATION OF RAYSKI.** G.Pócsik.
Acta phys. Hungar., Vol. 8, No. 3, 277-83 (1958).

The introduction of the operator of the total momentum is suggested and its properties are investigated. It is pointed out that the presence of the internal field induces, beside the local momentum of the field, an internal momentum completing it to the total one — the justification for its introduction being also supported by the investigation of the infinitesimal operator of rotation. Commutation rules corresponding to the usual ones are fulfilled. The generalization of the field equation is briefly discussed.

530.1

6680 **RADIANT ENERGY EMISSION FROM EXCITED HARMONIC OSCILLATORS.** S.S.Penner.
J. chem. Phys., Vol. 32, No.2, 617-18 (Feb., 1960).

Shows that the total radiant energy emitted by spontaneous ansitions for a fixed total energy input is independent of the initially xcited vibrational level, for harmonic oscillators. J.Hawgood

530.14

6681 ON THE SCHRÖDINGER EIGENVALUE PROBLEM.

O.Hellman.

Danske Vidensk. Selsk. mat-fys. Medd., Vol. 32, No. 4, 23 pp. (1960).

The problem is treated by a matrix method. A procedure or obtaining eigenvalues is developed for the following rather geneal cases (1) $l = 0$, and the potential function is assumed to be interable in the Lebesgue sence over a finite interval (0,L), vanishing lsewhere; (2) $l \neq 0$, and the potential is assumed to be of the form

$$\frac{a}{r^2} - \frac{b}{r} + V_0(r),$$

$V_0(r)$ possessing a power-series expansion within the interval (0, L) nd vanishing elsewhere (this expansion is not, however, needed n the calculations). The eigenvalues appear as roots of a rapidly onverging power series. The eigenfunctions are expressed directly n terms of the functions obtained in the process of forming the above ower series.

530.14 : 538.3

6682 ON THE SINGULAR ELECTROMAGNETIC FIELD IN A THEORY OF THE BORN–INFELD TYPE.

I. Kremer and S.Kichenassamy.

C. R. Acad. Sci. (Paris), Vol. 250, No. 4, 1192-4 (Feb. 15, 1960).

In French.

Using a general Lagrangian, a theory is developed, in which the energy—momentum tensor reduces, in the singular case, to that of the Born—Infeld theory and the theory of Maxwell. T.R.Carson

538.3 : 530.14

ON THE SINGULAR ELECTROMAGNETIC FIELD IN A THEORY OF THE BORN–INFELD TYPE. See Abstr. 6682

530.14

6683 EUCLIDEAN GAUGE TRANSFORMATION.

J.Schwinger.

Phys. Rev., Vol. 117, No. 5, 1407-8 (March 1, 1960).

The Green's function gauge transformation induced by the elimination of the longitudinal field in Euclidean electrodynamics is discussed.

530.14

6684 HAMILTONIAN FORMALISM ASSOCIATED WITH THE NAKANO ROTATOR.

F.Halbwachs, P.Hillion and J.P.Vigier.

C.R. Acad. Sci. (Paris), Vol. 250, No. 3, 471-3 (Jan. 18, 1960).

In French.

The canonical formalism is extended to the case of a Lagrangian which depends on the acceleration and applied to the study of the relativistic rotator. The canonical equations admit of solutions which are in agreement with results obtained otherwise. T.R.Carson

530.14

6685 IRREGULAR COULOMB WAVE FUNCTIONS.

A.Learner and B.A.Robson.

Austral. J. Phys., Vol. 12, No. 1, 94-7 (March, 1959).

Presents a table like that given for the regular functions in Abstr. 6653 (1958) for the same parameter ranges. J.Hawgood

STATISTICAL MECHANICS
TRANSFER PROCESSES

530.16

6686 A SIMPLE PROOF OF WICK'S THEOREM IN STATISTICAL MECHANICS.

M.Gaudin.

Nuclear Phys., Vol. 15, No. 1, 89-91 (Feb. [1], 1960). In French.

Wick's theorem in statistical mechanics is proved directly using commutation rules.

530.16

6687 ON THE STATISTICAL THEORY OF NONEQUILIBRIUM PROCESSES.

V.B Magalinskij and Ja.P.Terletskij.

Ann. Phys. (Leipzig), Folge 7, Vol. 5, No. 5-6, 296-307 (1960).

Further discussion of the method described in Abstr. 7721 (1958). The method is free from assumptions about small fluctuations, linear equations or Markov processes, requiring only the general principles of statistical mechanics and the "natural" hypothesis that the macroscopic equation of motion for the mean rate of change of a coordinate is of the same form as the microscopic equation of motion for a particle, apart from a constant force. A general diffusion equation is derived with this assumption, and several particular cases discussed. J.Hawgood

530.16

6688 THEORY OF IRREVERSIBILITY.

N.Saitô.

Phys. Rev., Vol. 117, No. 5, 1163-73 (March 1, 1960).

An isolated system is considered which is exposed to external perturbations such as electric fields. The current as a linear response to a single pulse of an electric field, namely the after-effect function, is a sum of terms periodic in time in a finite system, and does not vanish after a sufficiently long time. The transfer function is defined by the Laplace transform of the after-effect function with respect to time and thus has poles on the imaginary axis. By applying the idea of image charges in two-dimensional electrostatic problems to a certain property of the transfer function, it is shown that, in the limit of a large system, the poles on the imaginary axis are replaced by poles in the left-half plane and consequently the aftereffect function can really vanish. This fact yields the various aspects of irreversibility. It is also shown that the complex conductivity is expressed in terms of the residues of the poles of the transfer function distributed continuously on the imaginary axis, and, in particular, that the static conductivity is proportional to the residue of the pole at the origin which never exists in a finite system but appears in an infinite system. General reciprocal relations are given for both irreversible and reversible thermodynamics, and their connection to Onsager's and Maxwell's relations are discussed. An expression for the entropy production is given and a new interpretation of the H-function is proposed.

530.16 : 536.7

6689 IRREVERSIBLE THERMODYNAMICS AND CONTINUUM MECHANICS.

A.C.Eringen.

Phys. Rev., Vol. 117, No. 5, 1174-83 (March 1, 1960).

Principles of the irreversible thermodynamics are recapitulated. Using the basic conservation principles and the principles of irreversible thermodynamics, the fundamental equations and constitutive relations are obtained for fluids, solids and visco-elastic media. Equations for the entropy production and heat conduction are derived for various special media and for a general medium having internal constraints. For the latter case, a law generalizing Fourier's law of heat conduction is found.

530.16

6690 IRREVERSIBILITY OF SYSTEMS PERTURBED BY RANDOM FORCES.

V.E.Derr.

Phys. Rev., Vol. 117, No. 6, 1421-5 (March 15, 1960).

The irreversibility of quantum mechanical systems perturbed by random forces is investigated by means of phenomonological equations derived from the Schrödinger equation. A semiquantitative discussion depending on an assumption of time reversal symmetry of the ensemble of random functions leads to a description of the irreversibility of a system with a finite number of states. A more general quantitative method utilizing "smoothed" density matrices produces a macroscopic description of systems tending to equilibrium states.

530.16

6691 ON SOME STATISTICAL PROBLEMS INTRODUCED BY TIME OF FLIGHT TECHNIQUES AND BY THE STUDY OF THE FLUCTUATIONS IN TIMES OF FLIGHT.

A.Blanc-Lapierre and P.Dumontet.

C.R. Acad. Sci. (Paris), Vol. 250, No. 8, 1456-7 (Feb. 22, 1960).

In French.

Expressions are given for the standard deviations in the time interval measured in a time of flight method using a beam pulsed at random and periodically. A.Ashmore

530.16

6692 FLUCTUATIONS FROM THE NON-EQUILIBRIUM STEADY-STATE. M.Lax.

Rev. mod. Phys., Vol. 32, No. 1, 25-64 (Jan., 1960).

The main object of this paper is to generalise various results on fluctuations and noise in equilibrium systems. Existing work is surveyed (131 references) and a distinction is made between the macroscopic and microscopic viewpoints, the assumptions made in each case being listed. The relation between the Gaussian and Markoffian assumptions is also discussed. Various standard results are then generalised to apply to "driven" and to slightly non-linear systems, the necessary corrections and reservations being pointed out. H.N.V.Temperley

530.16

6693 INTRODUCTION TO THE DYNAMIC STUDY OF DIFFUSION PROCESSES. A.Régnier.

Ann. Inst. Poincare, Vol. 16, No. 2, 47-110 (1959). In French.

A fundamental mathematical analysis of the general diffusion process, based on the theory of stochastic processes. Brownian movement is presented as an illustration of a Markov process, and diffusion governed by Schrödinger's wave-equation as illustrating a non-Markov process. J.G.Oldroyd

530.16

6694 A CORNER EFFECT IN PLANE DIFFUSION THEORY. H.Levine.

Appl. sci. Rev. B, Vol. 8, No. 2, 105-27 (1960).

The partial differential equation of the diffusion type is studied in a plane sector of arbitrary angle, with the solution specified at the boundaries, and various expressions are obtained for the integrated normal derivative or flux thereto. Alternative methods of analysis are described for the right angle sector, which include an integral equation reformulation of the boundary value problem and its reduction to a functional or difference equation by Fourier transformation.

530.16

6695 A VERY GENERAL CLASS OF EXACT SOLUTIONS IN CONCENTRATION-DEPENDENT DIFFUSION.

J.R.Philip.

Nature (London), Vol. 185, 233 (Jan. 23, 1960).

A sufficient condition for the existence of exact solutions of the diffusion equation is set up, the diffusion coefficient depending on concentration through an arbitrary function which need only satisfy a few simple conditions. Some typical examples of such solutions, applicable to two physically interesting sets of boundary conditions, are listed. H.N.V.Temperley

530.16

6696 ON THE THEORY OF BROWNIAN MOTION. P.Mazur.

Physica, Vol. 25, No. 2, 149-62 (Feb., 1959).

It is shown that the non-Gaussian—Markoff process for Brownian motion derived on a statistical mechanical basis by Prigogine and Balescu, (Abstr. 8441 of 1957) and Prigogine and Philippot, (Abstr. 9019 of 1957) is related through a transformation of variables to the Gaussian—Markoff process of the conventional phenomenological theory of Brownian motion. First the mathematical equivalence of the two types of processes is established by expressing the well-known formulae and equations for the random process $\{v_x(t), v_y(t)\}$ which describe the motion of a charged Brownian particle in two-dimensional space under the influence of a magnetic field (v_x and v_y are the components of the velocity), in terms of the new variables $\epsilon = \frac{1}{2} m v_x^2 + \frac{1}{2} m v_y^2$ and $\alpha = \arccos\{v_x(2\epsilon/m)^{-1/2}\}$. The transformed process is called the $\{\epsilon(t), \alpha(t)\}$ process. It is then shown that the phenomenological theory of the Brownian motion of a strongly underdamped linear harmonic oscillator, if expressed in action-angle variables, leads under well specified conditions to the same $\{\epsilon(t), \alpha(t)\}$ process, i.e. to the process obtained by Prigogine and others in their statistical theory of irreversible processes (in which action-angle variables are used) for a system of weakly coupled harmonic oscillators.

530.16

6697 GREEN'S FUNCTIONS IN THE THEORY OF MANY FERMION SYSTEMS. M.Bolsterli.

Phys. Rev. Letters, Vol. 4, No. 2, 82-4 (Jan. 15, 1960).

In the spectral representation of the single-particle Green's function for N-fermion systems the intermediate states contain N + 1 particles, and the existance of a gap between the particle and hole parts of the spectral representation does not necessarily mean that there is a gap in the energy spectrum of the N-particle system An alternative single-particle Green's function, containing four Heisenberg operators, is defined, and it is shown that its spectral representation gives at least some of the excitation energies of the original system. E.J.Squires

530.1

6698 ON THE KINETIC THEORY OF A FLUID COMPOSED OF RIGID SPHERES. J.T.O'Toole and J.S.Dahler.

J. chem. Phys., Vol. 32, No. 4, 1097-106 (April, 1960).

This is studied by using the methods of statistical mechanics. It is confirmed that the equation of change for the singlet distributi function has precisely the form originally suggested by Enskog on t basis of intuitive arguments involving an appeal to the notion of forward and inverse collisions. The formal derivation of the hydro dynamical equations of motion for the fluid reveals that the flux tensors for the rigid sphere fluid are of the same general form as those for a fluid composed of molecules which interact according to nonimpulsive forces.

530.16

6699 FIRST COLLISION PROBABILITY, P_C, IN REGIONS WITH CIRCULAR SYMMETRY.

P.A.Jewitt and S.E.Barden.

J. nuclear Energy, Vol. 7, No. 3-4, 222-5 (Sept., 1958).

The method developed by Guggenheim and Pryce (1945) for the rigorous calculation of first collision probabilities in hollow tubes i extended to a geometry in which a solid cylindrical rod is surround by a concentric tube of the same material. This particular geometr is only a special case of the general problem associated with multi-annular tubes, and is investigated in order to determine the effectiv ness of smearing-out the solid material in such concentric regions uniformly within the outer perimeter of the tube.

530.1

6700 QUANTUM MECHANICAL MODIFIED BOLTZMANN EQUATION FOR DEGENERATE INTERNAL STATES.

R.F.Snider.

J. chem. Phys., Vol. 32, No. 4, 1051-60 (April, 1960).

A modified quantum-mechanical Boltzmann equation has been derived for the general case in which the molecules have degenerat internal states. This is an equation of the Boltzmann type for a quantity which is simultaneously a Wigner distribution function in molecular phase space, and a density matrix in internal state space In particular, the nondiagonal terms of this density matrix have bee included in the formalism, resulting in the collision term being modified from the usual Boltzmann expression. Thus the collisions are described in terms of combinations of the Lippmann—Schwinge scattering matrix rather than the collision cross-section. For nondegenerate states the usual collision term is obtained again.

530.1

6701 THE STATISTICAL INTERPRETATION OF THE IDEA OF THERMODYNAMIC EQUILIBRIUM. J.P.Guiraud.

C.R. Acad. Sci. (Paris), Vol. 250, No. 1, 70-2 (Jan. 6, 1960). In Fre

The problem of bringing two macroscopic assemblies together is re-examined in the light of recent work by Khintchine. It is claimed that the usual conclusions about mean values and equilibri can be justified without the customary assumption that one assemb is much larger than the other. H.N.V.Temper

530.1

6702 STATISTICAL DERIVATION OF QUANTIZED RADIATION AND GAS ENERGY. K.F.Novobátzky.

Acta. phys. Hungar., Vol. 10, No. 4, 407-19 (1959). In German.

Planck's radiation law is derived from the Boltzmann statistic of a system with sets of energy levels; the members of each set being spaced at equal intervals. Quantization is shown to be the consequence of the Nernst theorem, and h appears as the ratio of two classically known quantities. Well known results for a monatom gas are also derived. P.Gr

530.16 : 536

6703 THE ENTROPY OF A NON-EQUILIBRIUM IDEAL QUANTUM GAS. P.T.Landsberg.

Proc. Phys. Soc., Vol. 74, Pt 4, 486-8 (Oct., 1959).

It is assumed that the probability $P(N_1, N_2, \ldots)$ of finding a syst with N_i particles in the single particle quantum state i (i = 1,2,...) is factorizable. With this assumption, and the uniqueness theorem formation theory, the entropies are obtained. From these, the sual occupation numbers for equilibrium can be found by maximi- tion, without explicit appeal to ensemble distributions, Stirling's pproximation, etc. P.T.Landsberg

GENERAL MECHANICS

531

6704 ON THE RELATION BETWEEN CONGRUENCE CONDITIONS AND INDEFINITE [EQUILIBRIUM] EQUATIONS N CONTINUUM MECHANICS. F.Graiff.
.C. Accad. Naz. Lincei, Vol. 26, No. 6, 763-71 (June, 1959).
Italian.

531.1

6705 PHYSICS IN AUTO ACCIDENTS. G.Barnes.
mer. J. Phys., Vol. 28, No. 5, 498-501 (May, 1960).

A particular application of the fundamentals of physics with hich most physicists have little contact is discussed. Some lementary physics commonly used by law enforcement officers n the reconstruction of automobile accidents is reviewed. In articular, formulae for the determination of (a) vehicle speed hrough skid marks, (b) minimum speed for a vehicle skidding ff-course while turning a corner, (c) minimum speed required to oll a vehicle over sideways, and (d) centre of mass are discussed.

531.25

6706 THERMAL STRESSES DUE TO UNIFORM TEMPERATURE DISTRIBUTED OVER A BAND OF THE YLINDRICAL HOLE IN AN INFINITE BODY. P.Chowdhury.
ppl. sci. Res. A, Vol. 8, No. 6, 474-8 (1959).

The thermal stresses in an infinite isotropic elastic solid are btained when a band of the internal surface of a cylindrical hole in e solid is kept at a constant temperature.

531.25

6707 ON THE STRESSES IN TWISTED COMPOSITE SPHERICALLY ISTROPIC [ELASTIC] SHERES.
.P.Chattarji.
Bull. Calcutta Math. Soc., Vol. 50, No. 2, 99-102 (June, 1958).

531.25

6708 STRESSES DUE TO A FREE CIRCULAR HOLE IN AN INFINITE THIN ISOTROPIC PLATE UNDER CERTAIN ORMAL LOADINGS. W.A.Bassali.
ull. Calcutta Math. Soc., Vol. 50, No. 3, 107-22 (Sept., 1958).

531.25

6709 ON THE STRESSES IN TWISTED COMPOSITE [ELASTIC] PARABOLOIDS. P.P.Chattarji.
Bull. Calcutta Math. Soc., Vol. 50, No. 3, 155-8 (Sept., 1958).

The paraboloids are twisted by a distribution of shearing stresses n one curved surface, the other curved surface being held fixed.

531.25

6710 STRESSES AND STRAINS IN AN INFINITE ELASTIC SHEET UNDER A TENSION APPLIED AT TWO RIGID PAIRS OF SQUARE JAWS. D.G.Padfield and N.B.Dickinson.
Brit. J. appl. Phys., Vol. 9, No. 11, 448-52 (Nov., 1958).

First-order elastic theory of plane stresses is applied numerically to obtain estimates of the stresses in an infinite elastic sheet stretched in its own plane by forces applied at two rigid jaws. A similar method is applied (largely for purposes of comparison) to the stress in a strip tensioned by forces applied at rigid jaws extending across the whole width of the strip. As contrasted with relaxation methods, the procedure is well-suited to use with electronic computers.

531.25

6711 SOME EXACT SOLUTIONS OF THE CORRELATION EQUATIONS FOR THE COMPONENTS OF DEFORMATION TENSOR FOR SIMPLE LOADINGS. V.D.Bondar'.
Dokl. Akad. Nauk SSSR, Vol. 130, No. 6, 1218-19 (Feb. 21, 1960).
In Russian.

Exact solutions are possible when all components of the deformation tensor for simple loading are expressible in terms of a single component of that tensor. J.K.Skwirzynski

531.25

6712 FLEXURAL PROBLEMS OF CIRCULAR RING PLATES AND SECTORIAL PLATES. I.
W.A.Bassali and M.A.Gorgui.
Proc. Cambridge Phil. Soc., Vol. 56, Pt 1, 75-95 (Jan., 1960).

Explicit expressions in closed forms are first obtained for the complex potentials and deflection at any point of a circular annular plate under various edge conditions when the plate is acted upon by general line loadings distributed along the circumference of a concentric circle. These solutions are then used to discuss the bending of a circular plate with a central hole under a concentrated load or a concentrated couple acting at any point of the plate. Solutions for singularly loaded sectorial plates bounded by two arcs of concentric circles and two radii are also derived when the plate is simply supported along the straight edges. The boundary conditions along the circular edges include the cases of a free boundary as well as the elastically restrained boundary which covers the usual rigidly clamped and simply supported boundaries as special cases. The usual restrictions relating to the small deflection theory of thin plates of constant thickness are assumed. Limiting forms of the resulting solutions are investigated.

531.25 : 539.3

6713 A NOTE ON CALCULATIONS CONCERNING THE PLASTIC COMPRESSION OF THIN MATERIAL BETWEEN SMOOTH PLATES UNDER CONDITIONS OF PLANE STRAIN. W.Johnson and I.E.McShane.
Appl. sci. Res. A, Vol. 9, No. 2-3, 169-76 (1960).

The solution to this problem was originally given by Green (Abstr. 8268 of 1951) and consists of two distinct slip-line field solutions, and these fields were determined in a relatively complex way using the velocity equations. This note gives a method of approach to the problem which is easy to understand, and gives results demonstrating almost all the features mentioned in Green's paper. It is very simple to apply, but falls short in one important respect.

531.25 : 539.3

6714 PLANE STRAIN COMPRESSION BETWEEN ROUGH INCLINED PLATES. W.Johnson and H.Kudo.
Appl. sci. Res. A, Vol. 9, No. 2-3, 206-12 (1960).

The normal pressure distribution on rough plates, inclined at various angles, and the mean vertical pressure to effect a sideways expulsion of metal in terms of the plane-strain compressive yield stress of the material have been calculated using slip-line field solutions and conventional technological theory; the results are plotted for immediate use. A comparison of the results afforded by both these approaches is also made.

531.26

6715 RAPID COMPUTATION OF GRAVITATIONAL ATTRACTION OF THREE-DIMENSIONAL BODIES OF ARBITRARY SHAPE. M.Talwani and M.Ewing.
Geophysics, Vol. 25, No. 1, 203-25 (Feb., 1960).

An expression is derived for the gravity anomaly at an external point caused by a horizontal lamina with the boundary of an irregular polygon. This expression is put in a form suitable for computation by a high-speed digital computer. By making the number of sides of the polygon sufficiently large, any irregular outline can be closely approximated. Any three dimensional body can be represented by contours. By replacing each contour by a polygonal lamina, the anomaly caused by it can be obtained at any external point. By a system of interpolation between contours combined with a numerical integration the gravity anomaly caused by the three-dimensional body can be calculated to a high degree of precision. This method may also be used for rapidly computing terrain corrections on a flat earth. By making a small modification it can further be adopted for computing the terrain correction as well as local isostatic compensation on the Airy system up to the external radius of the Hayford zone O on a spherical earth. The expression for the anomaly caused by a horizontal polygonal lamina is also obtained for the special case when the sides of the polygon are alternately parallel to the x- and y-axes, that is, the polygonal lamina can be divided into a number of rectangular laminae. A chart is provided for the hand computation of the gravity anomaly in this case.

531.3

6716 ROTATION VIBRATION OF ELLIPTICAL VESSELS CONTAINING LIQUIDS. J.Satterly.

Amer. J. Phys., Vol. 27, No. 2, 119-20 (Feb., 1959).

The effect of various liquids on the moment of inertia of cylindrical, spherical and elliptic vessels as well as the effect in ellipsoidal vessels using fresh and hard boiled eggs have been measured. The results agree with a relation given by Inglis (Abstr. 4265 of 1958) $I(\text{Liquid}) = D/R^2\, I(\text{solid})$, $D = (a-b)$ and $R = (a + b)/2$ where a, b are the major and minor axes of the ellipse. In the case of cylindrical vessels $D/R^2 = 0$ and the ratio $I(\text{water})/I(\text{solid})$ found $= 0.01$. In general the viscosity and ellipticity are the main factors in the increase of inertia due to liquid while density has very little effect. T.C.Toye

531.3

6717 STABLE AND UNSTABLE TRAJECTORIES OF PROPORTIONAL NAVIGATION. V.L.Kan and A.S.Kel'zon.

Dokl. Akad. Nauk SSSR, Vol.130, No. 6, 1220-3 (Feb. 21, 1960).
In Russian.

The authors derive trajectories for integral values on the navigational constant b, other than b = 2. The solutions are best considered separately, for even and for odd values of b. The stability regions are obtained and discussed for the particular case of b = 4. J.K.Skwirzynski

531.4

6718 INVESTIGATION INTO ONE OF THE ASSUMPTIONS OF THE HERTZ THEORY OF CONTACT. C.Storey.

Brit. J. appl. Phys., Vol. 11, No. 2, 67-8 (Feb., 1960).

One of the limitations of Hertz's solution of the contact problem is the assumption that, in the neighbourhood of contact, the surfaces of the bodies and, hence, the distance between their corresponding points can be represented by second degree equations. Subsequent theoretical work, mainly by Shtaerman, has provided a more general solution free from this limitation. It is the purpose of the present work to examine the effect of the inclusion of terms of higher degree than the second in the expression for the distance between the two bodies. Attention is confined to spheres and cylinders.

531.5

6719 A PROBLEM ON HIGH SPEED PROJECTILES. S.Owada.

J. Coll. Arts Sci. Chiba Univ., Vol. 2, No. 3, 261-5 (March, 1959).
In Japanese.

In the analysis of high-speed projectiles, the self-rotation of the earth must be considered. To avoid complication due to centrifugal and Coriolis forces, the motion of the projectile and the earth are treated referring to absolute systems of coordinates. The problem of obtaining the conditions of projection to fly projectiles from a given point to a distant aimed point on the earth is discussed.

MECHANICAL MEASUREMENTS

531.7

6720 REPORT OF THE 44TH NATIONAL CONFERENCE ON WEIGHTS AND MEASURES 1959.

Misc. Publ. Nat. Bur. Stand., No. 228, 144 pp. (1959).

Sponsored by the National Bureau of Standards and held in Washington, D.C., June 8-12, 1959.

531.71 : 621.317.39

6721 MICROWAVE THICKNESS DETECTOR. J.B.Beyer, J.Van Bladel and H.A.Peterson.

Rev. sci. Instrum., Vol. 31, No. 3, 313-16 (March, 1960).

A device is described which is capable of continuously measuring the thickness of moving conducting materials. The details of two independent methods, one utilizing the amplitude and one the phase of reflected microwave energy, are explained and compared. Experimental results verify that increments of the order of 1/40 mm are clearly detectable.

531.71 : 621.382

6722 A GAUGE FOR THE PRECISION MEASUREMENT OF THE THICKNESS OF GERMANIUM AND SILICON WAFERS. D.Baker.

Proc. Instn Elect. Engrs, Paper 2891 E, publ. May, 1959 [International Convention on Transistors and Associated Semiconductor Devices], Vol. 106B, Suppl. 17, 1168-70, 1181 (1959).

Republication, with discussion, of the paper already abstracted in Abstr. 4330 (1959).

531.74 : 535.4

DETERMINATION OF PARALLELISM OF WORK PIECES UP TO SEVERAL METRES IN LENGTH WITH THE HELP OF OPTICAL INTERFERENCE. See Abstr. 5177

531.7

6723 SIMPLE DEVICE FOR USE WITH PLATFORM WEIGHBRIDGES IN THE ACCURATE DETERMINATION OF BURNING RATES. J.E.Roughton.

J. sci. Instrum., Vol. 37, No. 2, 45-6 (Feb., 1960).

The device comprises an automatically adjusted "chain rider" which permits measurement of small weight changes to better than ±½ oz with a normal 5 cwt platform weighbridge.

531.78 : 621.317.39

6724 RECORDING WEIGHT METER. D.J.Steele.

J. sci. Instrum., Vol. 37, No. 1, 27-30 (Jan., 1960).

Modifications to a commercial platform weighing machine, to provide a continuous record of changes in weight of a standing load on the platform, are described. With this instrument, weight chang of up to 55 lb in a maximum load of 560 lb can be recorded to an accuracy of 0.5%, i.e. less than 5 oz, which is the accuracy of the wei ing machine itself. An earlier instrument, although satisfactory for short periods of operation, was found to be unsatisfactory for measu ring weight changes over a time in excess of a few hours, owing to random changes of up to 2 lb in full-scale calibration of 50 lb. This difficulty has been overcome in the present instrument by using pho toelectric cells to detect the vertical movement of the steelyard, an a servo-operated mechanism to control the restoring force. The out put, which is directly proportional to the change in weight on the platform, is in a form which is suitable for being recorded on a potentiometric recorder. It is substantially independent of normal ambient temperature changes; the calibration changes by 0.01% per deg F change of ambient temperature. This error can be allowed for if the ambient temperature changes are known.

531.7

6725 NOTE ON A NEW DESIGN FOR THE CENTRIPETAL FORCE APPARATUS. H.S.C.Chen.

Amer. J. Phys., Vol. 28, No. 4, 377-9 (April, 1960).

A new design is given for the centripetal force apparatus such that any two of the three variables, mass, angular velocity, and distance, may be kept constant while the centripetal force is determined as a function of the third variable. Typical experimental results are given.

MECHANICS OF FLUIDS

(See also Magnetohydrodynamics)

532.

6726 ON THE AXIOM OF INCOMPRESSIBILITY. G.Bouligand.

C.R. Acad. Sci. (Paris), Vol. 249, No. 23, 2452-4 (Dec. 9, 1959).
In French.

A theoretical model discussion of turbulence and incompressibility. T.C.Toy

532.

6727 THE FLUID COLUMN. B.D.Mills, Jr.

Amer. J. Phys., Vol. 28, No. 4, 353-6 (April, 1960).

When a piece of metal tubing is filled with fluid under pressure it has been found that the tube may buckle elastically by lateral deflection, before it either yields or bursts. Analysis and experime show that the behaviour is much like the buckling of an ordinary column subjected to axial compression.

532.1 : 539.21

6728 MEASUREMENT OF THE DENSITY OF GRANULAR SOLIDS AND LIQUIDS. M.Chopin and G.Chopin.

C.R. Acad. Sci. (Paris), Vol. 250, No. 3, 480-2 (Jan. 18, 1960).

In French.

The error in the liquid displacement method of measuring the density of granular solids which is due to trapped air bubbles can be avoided by using a closed metal container. When this is dropped from a height of two feet the impact shock dislodges the bubbles. The same method can be used for frothy liquids. T.S.E.Thomas

532.1

6729 VISCOSITY MEASUREMENT. THE KINETIC ENERGY CORRECTION AND A NEW VISCOMETER.

M.R.Cannon, R.E.Manning and J.D.Bell.

Analyt. Chem., Vol. 32, No. 3, 355-8 (March, 1960).

Results are presented of extensive studies of the magnitude of the kinetic energy correction in spectral viscometers, designed to magnify this correction, and in the various types of capillary viscometer. A simple correlation was developed which takes into account the fact that the kinetic energy coefficient (m) varies with Reynolds number. A new improved viscometer is described which has a negligible kinetic energy correction over a viscosity range of 0.4 to 20 000 centistokes. It is claimed to be excellent for precision work in kinematic dilution and intrinsic viscosity.

532.1

6730 THEORETICAL EVALUATION OF CAPILLARY VISCOMETERS FOR THE MEASUREMENT OF THE VISCOSITY OF SUSPENSIONS OF SPHERES.

A.D.Maude.

Brit. J. appl. Phys., Vol. 10, No. 8, 371-6 (Aug., 1959).

The effect of the presence of stable, equi-sized spheres suspended at low concentration in a Newtonian fluid on the viscosity when measured in a capillary-tube viscometer is compared with that in an idealized viscometer. The result of the curvature of the velocity profile is found, and that of mechanical interaction with the tube wall is evaluated. Reynold's number, tube length and the quantity flowing before a steady state is established are also considered, as is the effect of the presence of the rigid wall on the perturbation velocity fields. These theoretical results are compared with published data, and it is concluded that some other factor, beside those considered, must be operating.

532.1 : 541.18

6731 INTERACTION BETWEEN TWO EQUAL-SIZED EQUAL-SETTLING SPHERES MOVING THROUGH A VISCOUS LIQUID.

G.F.Eveson, E.W.Hall and S.G.Ward.

Brit. J. appl. Phys., Vol. 10, No. 1, 43-7 (Jan., 1959).

The distances between sphere centres was varied and the line of centres was at various angles to the horizontal. The results are represented by simple empirical equations. These results are discussed in relation to theoretical predictions.

532.1

6732 A GRAPHICAL METHOD FOR DETERMINING THE COEFFICIENT OF VISCOSITY OF NON-ELASTIC LIQUIDS. IV.

Ali Abdel-Kerim Ibrahim.

Acta phys. Hungar., Vol. 10, No. 2, 249-50 (1959).

For previous part, see Abstr. 13050 (1959). The oscillation through very small amplitudes of one of the cylinders of a concentric cylinder viscometer which is filled with a non-elastic liquid produces a phase lag that depends upon the viscosity of the liquid. The viscosity in turn depends upon the oscillation frequency. For an oil which has been measured by Markovitz et al. (Abstr. 8510 of 1952) at a particular frequency to 88.92 P, the author derives graphically 91.6 P. R.Schnurmann

532.1

6733 THEORY OF THE PARALLEL PLATE VISCOMETER.

A.N.Gent.

Brit. J. appl. Phys., Vol. 11, No. 2, 85-7 (Feb., 1960).

The theoretical treatment for the rate of approach of two parallel circular plates separated by a viscous liquid is subject to the limiting condition that the separation of the plates must be small compared to the test-piece radius. The theory is extended to apply to test-pieces of any thickness and the modified treatment is shown to be in accord with experimental measurements on a sample of coal-tar pitch.

532.1 : 536.2

6734 A RELATIONSHIP FOR THE VISCOSITY AND THERMAL CONDUCTIVITY OF LIQUIDS AND GASES.

I.I.Novikov.

J. nuclear Energy, Vol. 6, No. 4, 370 (May, 1958). English translation of article in: Atomnaya Energiya, Vol. 2, 468 (1857).

Because of the symmetry of the equilibrium phase diagram near the critical point, it is to be expected that the viscosity of the liquid phase (μ') in equilibrium with the saturated vapour, and the viscosity of the saturated vapour (μ'') phase near the critical point (i.e. at temperatures near the critical temperature, t_c) will approximately satisfy the simple relationship:

$$1/\mu' + 1/\mu'' = 2/\mu + a(t_c - t)$$

where μ is a constant, numerically equal to the viscosity at the critical point. This expression is derived by analogy with the well-known relation between the densities of a liquid and its saturated vapour, near the critical point. An analysis of experimental data shows that near t_c, $(1/\mu' + 1/\mu'')$ slowly decreases linearly with temperature. For CO_2, to high degree of accuracy:

$$1/\mu' + 1/\mu'' = 6330 + 13(t_c - t).$$

An analogous expression to that for viscosity is derived for thermal conductivity.

532.1

6735 VISCOUS PROPERTIES OF THIXOTROPIC MATERIALS.

D.G.Osborne and S.Thornton.

Brit. J. appl. Phys., Vol. 10, No. 5, 214-19 (May, 1959).

Measurements have been made on the viscous properties of thixotropic suspensions of titanium dioxide pigments in linseed stand oils. The effects of changes in concentration and temperature have been noted. The viscosity under steady flow conditions cannot be adequately defined by a single coefficient but it is convenient to display the results graphically, plotting shear stress against velocity gradient. It is shown that the shear stress required to maintain any steady velocity gradient has two components, one being independent of temperature and the other proportional to the viscosity of the medium as this changes with temperature. The samples studied took some time to attain steady conditions of flow and the approach to this state, the "thixotropic relaxation", occurs in a very complicated way. Two qualitative conclusions could be drawn: that the magnitude and speed of thixotropic change decreased with increasing values of shear stress, and that the magnitude and speed of thixotropic change (at the same shear stress) increased with increasing concentration.

532.1

6736 SOME MEASUREMENTS OF THE TIME DEPENDENCE OF THE VISCOSITY OF THIXOTROPIC FLUIDS.

E.W.Billington.

Proc. Phys. Soc., Vol. 75, Pt 1, 40-50 (Jan., 1960).

The time dependence of the viscosities of certain thixotropic fluids has been measured at constant rate of shear, using a Couette type viscometer. A time-dependent yield value has been introduced which related the instantaneous value of the observed viscosity, for a given rate of shear, to a time-independent residual viscosity. The transient behaviour of the yield value has also been examined.

532.5

6737 SURFACE MOLECULAR KINEMATICS.

R.F.Simonin.

C.R. Acad. Sci.(Paris), Vol. 250, No. 10, 1798-800 (March 7, 1960). In French.

Experiment supports the theory that, when a jet of water falls vertically into a reservoir, there is a continual replacement of molecules in the free surface by molecules from the surface of the jet. In the steady state the free surface of the reservoir is depressed by the jet into the form of a surface of revolution of constant total curvature (i.e. of minimum area). J.G.Oldroyd

532.5 : 551.5 : 536.25

FLUID MODEL TO DESCRIBE INFLUENCE OF ROTATION ON CONVECTION. See Abstr.5208

532.5

6738 FINITENESS OF VARIATION OF THE CONTINUOUS SOLUTIONS OF THE HYDRODYNAMICAL EQUATIONS.

A.M.Molchanov.

Dokl. Akad. Nauk SSSR, Vol. 129, No. 6, 1257-60 (Dec. 21, 1959). In Russian.

Absolute convergence of the space integral of hydrodynamical variables is proved. R.Eisenschitz

532.5

6739 THREE-DIMENSIONAL WEDGE IMPACT ON A COMPRESSIBLE FLUID. S.F.Borg.

J. appl. Phys., Vol. 31, No. 2, 438-9 (Feb., 1960).

A pressure distribution for a spherically symmetric compressible flow superposed on one corresponding to an axially symmetric elastic deformation can be made to satisfy the boundary conditions at an instant when a compressible fluid with a plane free surface is subjected to a hemispherical impact indentation.

J.G.Oldroyd

532.5

6740 ESTIMATION OF PRANDTL NUMBERS. D.S.Davis.

Chem. Process Engng, Vol. 41, No. 4, 127 (April, 1960).

The Prandtl numbers (Pr) of many liquids can be estimated by means of Denbigh's equation, $\log \mathrm{Pr} = 100\ \Delta HT^{-1} - 1.8$, where T is the temperature in °K and ΔH the molal latent heat of vaporization in kg cal. A nomogram is given for the quick and accurate solution of this equation.

532.5

6741 APPLICATION OF FINITE HANKEL TRANSFORM TO A PROBLEM IN PERFECT FLUID FLOW. N.K.Jaiswal.

Bull. Calcutta Math. Soc., Vol. 50, No. 2, 84-6 (June, 1958).

532.5

6742 APPROXIMATION OF REYNOLDS' EQUATION. Ya.M.Kotlyar.

Dokl. Akad. Nauk SSSR, Vol. 130, No. 1, 41-4 (Jan. 1, 1960). In Russian.

The equation

$$\{\partial[Q^2(\partial P/\partial x)]/\partial x\} + \{\partial[Q^2(\partial P/\partial y)]/\partial y\} = 0$$

is used in the theory of lubrication; here, Q is a given function of 1 or 2 variables and P is the unknown function. A method is developed for solving the differential equation by substituting for Q approximate functions for which the unknown function is simple to obtain.

R.Eisenschitz

532.5

6743 THE EFFECT OF REYNOLDS NUMBER ON THE FLOW LOSSES IN PLANE (TWO-DIMENSIONAL) CASCADES. K.Gersten.

Abhandl. Braunschw. Wiss. Gesell., Vol. 11, 5-19 (1959). In German.

Survey. The Reynolds number effect depends on the pressure distribution of the blade, on the transition from laminar to turbulent flow, and on the surface roughness. Generally, the losses decrease considerably when the Reynolds number increases; also, the flow pattern through the cascade changes considerably with variation of the Reynolds number. There are three different types of flow in the boundary layer: separation of the laminar boundary layer near the leading edge at low Reynolds numbers; local separation of the laminar boundary layer enclosing a "bubble of turbulence"; at high Reynolds numbers the usual transition from laminar to turbulent flow, with separation of turbulent boundary layer near the trailing edge. It can be shown that the Reynolds number effect on the flow losses can be calculated fairly accurately by theoretical methods, as long as the separation of boundary layer is insignificant.

532.5

6744 A NOTE ON THE MOTION OF VISCOUS FLUID SUBJECTED TO UNIFORM OR PERIODIC BODY FORCE ACTING FOR A FINITE TIME. S.Datta.

J. Technol. (Calcutta), Vol. 3, No. 2, 73-9 (Dec., 1958).

The motion of a viscous incompressible fluid between two parallel planes and through a circular pipe is considered, it being assumed that a uniform or periodic body force acts for a finite time only.

532.5

6745 VISCOUS FLOW ROUND A SPHERE AT LOW REYNOLDS NUMBERS (<40). V.G.Jenson.

Proc. Roy. Soc. A, Vol. 249, 346-66 (Jan. 13, 1959).

Relaxation methods are outlined, and the present problem formulated in modified spherical polar co-ordinates. The results of calculations made for R = 5, 10, 20, 40 are presented in the form of stream function and vorticity distributions; and further results of pressure distributions, velocity distributions, and drag coefficients, calculated from them. These results are shown to compare favourably with experimental work, showing a steady trend from symmetrical Stokes's flow, towards boundary layer flow. The phenomenon of separation of the forward flow and development of a circulating wake, is explained and illustrated, the first formation of a wake being at R = 17.

532.5 : 530.12

A RELATIVISTIC ANALOGUE OF A SIMPLE NEWTONIAN RESULT. See Abstr. 6645

532.5

6746 MOTION INDUCED BY A SPHERE VIBRATING ALONG THE AXIS OF ROTATION OF AN INFINITE ROTATING LIQUID. D.Mallick.

Proc. Nat. Sci. India A, Vol. 23, No. 6, 544-59 (1957).

The problem of a sphere set vibrating at time t = 0 along the axis of rotation of an infinite inviscid liquid, has been considered. Linearized equations have been used in this study. As in Stewartson' case (Abstr. 2455 of 1952) discontinuities appear in the ultimate motion. In a limiting case the present results reduce to those of Stewartson.

532.5

6747 ROTATION OF A PLANE LAMINA IN A VISCO-ELASTIC LIQUID. S.K.Sharma.

Appl. sci. Res. A, Vol. 9, No. 1, 43-52 (1959).

Devoted to a study of the problem of rotation of a infinite plane lamina coinsiding with the plane z = 0 and rotating about the axis r = 0 with constant angular velocity Ω in a visco-elastic fluid, whose rheological behaviour at small rates of shear may be represented by a stress—strain law (Abstr. 3757 of 1958). The equations are reduced to dimensionless ordinary differential equations and solved by the Kármàn—Pohlhausen method. The effect of elasticity is shown to depend upon two dimensionless parameter τ^* and κ. The model given by $\tau^* = 2\kappa$ is studied in detail. Comparison with the viscous case shows that elasticity decreases the transverse velocity and increases the axial velocity towards the plate throughout the boundary layer region. A new phenomenon is observed in connection with the radial velocity in that it increases near the plate in certain parts and decreases in the remaining parts of the boundary layer region with an increase in the elasticity parameters. The transition point where the radial velocity in the visco-elastic case is the same as in the viscous non-elastic case has been located in some cases. This point shifts towards the plate with increasing elasticity. The boundary payer thickness increases with an increase in the values of the parameters. Also, if edge effects are neglected, elasticity is shown to decrease the frictional moment on the plate.

532.5

6748 UNSTEADY CIRCULATORY FLOW ABOUT A CIRCULAR CYLINDER WITH SUCTION. R.S.Nanda.

Appl. sci. Res. A, Vol. 9, No. 2-3, 85-92 (1960).

The complete Navier—Stokes equations which describe the unsteady flow of a viscous incompressible fluid when an infinite circula cylinder is given an impulsive twist, and simultaneously a constant suction velocity is imposed on the cylinder, are integrated using Laplace transforms. It is found that the flow at points which are at a greater distance from the cylinder is steadier than that at points closer to the cylinder. Unsteady flow through a concentric annulus is also considered.

532.5

6749 A THEORETICAL STUDY OF STABILITY IN WATER FLOW THROUGH HEATED PASSAGES. H.Chilton.

J. nuclear Energy, Vol. 5, No. 3-4, 273-84 (1957).

Criteria defining the stability of forced water circulation through heated passages are introduced. A general method is derived for predicting stability criteria for a system with any form of variation of heat input with respect to passage length. A convenient method for calculating pressure loss is developed. Criteria and integrated functions are presented for the forms of heat-input distribution commonly encountered in reactor design, and their applicatio is demonstrated in a worked example.

532.5

6750 NON-NEWTONIAN FLOW AND THE OIL SEAL PROBLEM. R.I.Tanner.

J. mech. Engng Sci., Vol. 2, No. 1, 25-8 (March., 1960).

It appears to be difficult to explain the action of oil seals if the fluid is regarded as Newtonian. A possible hypothesis is that the fluid, when subjected to extremely high shear rates, behaves in a non-Newtonian manner. Utilizing a fairly general stress/strain-rat relation, a simplified analysis of the seal problem is given. Comparison with the currently available experimental work shows that non-Newtonian effects are not likely to provide a complete explanation of the oil-seal problem.

532.5

6751 AN UNMIXING DEMONSTRATION.

J.P.Heller.

Amer. J. Phys., Vol. 28, No. 4, 348-53 (April, 1960).

It is pointed out that the usual mathematical description of the slow flow of viscous liquids within rigid boundaries indicates that such motion is reversible in time. The equations of a mixing transformation, in the geometry of the Couette viscometer, are given. The motion is ideally quite reversible, but because the fluid consists of molecules subject to thermal agitation, the pattern is smeared out in time. Observed unmixing by reversal of motion, although striking, is not perfect.

532.5

6752 CERTAIN CASES OF MOTION OF TWO-COMPONENT MIXTURES.

Ya.Z.Kleiman.

Akust. Zh., Vol. 5, No. 3, 301-13 (1959). In Russian.

Deals with certain cases of non-stationary motion of two-component media using the acoustic approximation and allowing for friction between components. The cases discussed are: flow of the mixture from a tube, propagation of a perturbation which arose at the medium boundary, explosions. By way of illustration the author discusses in detail the case of water-saturated sand. [English translation: Soviet Physics—Acoustics (New York), Vol. 5, No. 3, 308-19 (Feb., 1960)]. A.Tybulewicz

532.5

6753 MIXING OF COAXIAL STREAMS INSIDE A CLOSED CONDUIT.

S.Mikhail.

J. mech. Engng Sci., Vol. 2, No. 1, 59-68 (March, 1960).

The linearized integral equations of motion are used to solve the problem of turbulent mixing of two coaxial streams inside a closed conduit. Similar to the problem of mixing of unbounded coaxial streams, the problem is too complicated to be solved by the equations of motion, but by specifying a shape for the velocity distribution across the streams at all normal sections, the solution has been simplified. For every region of the mixing regions, the radius of the core, the external radius of the inside stream and the velocity on the axis are determined by the integral equations of motion. The solutions are then joined by making the velocity and radius continuous at the transition sections. In this way a complete picture of the flow pattern is obtained. Experimental data are presented from a coaxial air to air jet-pump having a mixing chamber of constan diameter. The data consists of complete velocity traverses and wall static pressure taken at different flow ratios. The primary and secondary streams were of the same density, incompressible, subsonic and isothermal. The main conclusion from the experiments is that the theory gives an overall picture of the mixing process which is in the main correct, though it might be inaccurate in some of the details.

532.5

6754 EXPERIMENTAL DETERMINATION OF THE ATOMISING EFFICIENCY OF A HIGH-SPEED SPINNING DISK ATOMISER.

D.J.Ryley.

Brit. J. appl. Phys., Vol. 10, No. 4, 93-7 (Feb., 1959).

For earlier work see Abstr. 5690 (1958). Electrically driven disks of 3 and 5 cm diameter were rotated at speeds 20 000 - 60 000 rev/min, and samples of an aqueous spray were analysed for flow rates of 0.12, 0.42 and 0.77 cm^3/sec. The reduction in disk speed during atomizing was determined experimentally using an electronic pulse counter and a miniature dynamometer was devised to simulate this reduction and measure the power consumed. Atomizing efficiencies for the electrically driven disk thus obtained are compared briefly with the efficiency employing air drive and also with that of a simple pressure atomizer. In all cases efficiencies are less than 0.5%.

532.5 : 541.18

6755 ANALYSIS OF A POLYDISPERSE AQUEOUS SPRAY FROM A HIGH-SPEED SPINNING DISK ATOMIZER.

D.J.Ryley.

Brit. J. appl. Phys., Vol. 10, No. 4, 180-6 (April, 1959).

The analysis covers experiments made using flat rotating disks of 2, 3 and 5 cm diameter having controlled matt working surfaces. Rotational speeds varied from 19 000-70 000 rev/min and water feed rates were 0.121, 0.421 and 0.771 g/sec. The independent variation of Sauter mean diameter (S.m.d.) and of maximum droplet diameter with disk size, liquid flow rate and rotational speed were found and the general correlation is expressed using dimensionless groups. The extent of the dispersion is numerically expressed as a Rosin—Rammler distribution constant. Good correlation was found between both (a) S.m.d. and (b) maximum droplet diameter, and the appropriate products of dimensionless groups. The distribution constant is expressed empirically in terms of speed and flow rate, but the correlation is less satisfactory than in the case of (a) and (b). No information is given on the mode of fracture, but limitations of the analytical method are explored.

532.5

6756 INSTABILITY OF ROTATING CYLINDRICAL JETS.

J.Ponstein.

Appl. sci., Res. A, Vol. 8, No. 6, 425-56 (1959).

A mathematical treatment is given of the instability of rotating cylindrical jets under the action of the inertial effects of the jet and its surface tension. Three types of jet are considered: (a) the one whose liquid fills the space within a cylinder (solid jet); (b) the one whose liquid fills the space between two cylinders (hollow jet); (c) the one whose liquid fills the space on the outside of a cylinder (hollow, infinitely thick jet). In general the viscosity of the liquid and the inertial effects of the surrounding air have been neglected except in two cases: (1) For the non-rotating solid jet, the influence of the liquid viscosity is taken into account, while the inertial effects of the surrounding air are neglected, especially for rotationally symmetric perturbations. (2) For the rotating solid jet, the influence of the inertial effects of the surrounding air is taken into account, while the liquid viscosity is neglected. Here the undisturbed velocity field for the air is put equal to zero or is chosen in such a way that the overall velocity field is continuous at the interface between liquid and air. The following conclusions may be drawn: (A) If the liquid viscosity and the inertial effects of the ambient air are neglected: (1) The instability of the jets becomes greater if the ratio between their dynamic surface tension and the liquid density becomes greater. (2) In some cases non-rotationally symmetric perturbations are more unstable than rotationally symmetric ones. (3) The non-rotating jet is stable to perturbations whose wave number in a tangential direction is a positive integer. (4) The perturbations of the solid and hollow, infinitely thick jets are unstable if the wave number in axial direction lies in a finite interval between zero and a certain critical value, or if the wave number in a tangential direction takes the value zero or any integral value below a critical integer (only positive wave numbers are considered). (5) The solid jet is more unstable as it rotates faster; then the critical wave numbers in both axial and tangential directions are raised. (6) The hollow, infinitely thick jet is the more stable as it rotates faster; then the critical wave numbers in both axial and the tangential direction are lowered. (B) If the inertial effects of the ambient air or the liquid viscosity are taken into account: (7) The influence of the inertial effect of the ambient air on the solid jet may be neglected if the density of the air is small compared with the density of the liquid and if the velocity field is continuous at the interface. (8) The instability range of the wave number in an axial direction for solid (non-rotating) jets with low liquid viscosity is the same as that for solid jets with zero liquid viscosity for rotationally symmetric perturbations. The amplitude of the perturbations, however, grows somewhat more slowly with time than in the case of zero viscosity.

532.5

6757 EFFECT OF COMPRESSIBILITY ON THE DISCHARGE COEFFICIENT OF ORIFICES AND CONVERGENT NOZZLES.

S.L.Bragg.

J. mech. Engng Sci., Vol. 2, No. 1, 35-44 (March, 1960).

It has been known for some time that when a gas flows through an orifice the coefficient of discharge increases as the ratio of the downstream pressure to the upstream pressure is reduced. This increase continues even after the critical (sonic) pressure ratio is passed, since, unless the discharge coefficient of the orifice is already unity, the mean velocity in the plane of the orifice is still subsonic and can be influenced by the downstream pressure. Jobson (1955) suggested a method by which the variation of discharge coefficient with pressure ratio could be calculated. The method was based on the assumption that the velocity pattern at the walls, upstream of the orifice was independent of flow rate: it yielded results that were in good agreement with experiments on sharp-edge orifice. The assumption breaks down, however, and leads to demonstrably false results, when the discharge ceofficient is greater than about 0.65 and the pressure ratio well away from unity, since the upstream velocity pattern is then affected by compressibility. In the present paper, a simple assumption about the flow pattern at the walls enables allowance to be made for this additional compressibility effect. The resulting curves of discharge coefficient against pressure ratio are then correct for a perfect nozzle, with a discharge coefficient of unity, as well as for a Borda mouth-piece, and so might be expected to be reasonable approximations in between these extremes. Experimental results from a variety of sources have been compared with the theoretical predictions. The agreement is good at pressure ratios up to the critical but very few results at really low pressure ratios are available. It should perhaps be emphasized that neither Jobson's nor the present method of analysis enables the discharge coefficient of a particular orifice to be calculated ab initio. Their object is to predict how the discharge coefficient of a particular nozzle, known under one set of flow conditions, will vary under others.

532.5

6758 THE EXACT SOLUTION OF BORDA'S MOUTHPIECE IN TWO DIMENSIONS. C.A.Hachemeister.

Quart. appl. Math., Vol. 17, No. 3, 299-304 (Oct., 1959).

Two-dimensional irrotational flow from a reservoir through a Borda mouthpiece of finite length (in the direction of the jet) is analysed by making use of a succession of conformal transformations of the complex-potential and complex-velocity planes. The coefficient of contraction, and the maximum surface speed in the reservoir and its location, are determined for all values of the length/width ratio of the mouthpiece and ultimate jet speed.

J.G.Oldroyd

532.5

6759 ON CHANDRASEKHAR'S THEORY OF TURBULENCE. P.C.Jain.

Proc. Nat. Inst. Sci. India A, Vol. 23, No. 6, 504-13 (1957).

The theory of Chandrasekhar (Abstr. 4408 of 1955) has been generalised to the case of axisymmetric turbulence, and eight differential equations in eight defining scalars of double and triple correlation tensors have been deduced. Two of these equations are the modified forms of the equations obtained by Chandrasekhar (Abstr. 5558 of 1950) on the basis of old theory and, therefore, these equations replace the equation of Von Karman and Howarth in the theory of isotropic turbulence (Abstr. 457 of 1938).

532.5

6760 ON DECAY OF ENERGY SPECTRUM OF ISOTROPIC TURBULENCE. N.R.Sen.

Proc. Nat. Inst. Sci. India A, Vol. 23, No. 6, 530-3 (1957).

The family of self-preserving solutions of Heisenberg's equation for decay of isotropic turbulence has been examined. It appears from an examination of the stability of the spectrum associated with the fourth power law for small k that the solution of Heisenberg and Chandrasekhar represents the most stable member of the family to which possibly all previous labile motions converge.

532.5

6761 DENSITY FLUCTUATIONS IN TURBULENCE IN AN INVISCID COMPRESSIBLE FLUID. P.C.Jain.

Proc. Nat. Inst. Sci. India A, Vol. 24, No. 1, 40-4 (1958).

The new theory of turbulence as presented by S.Chandrasekhar (Abstr. 4408 of 1955) has been applied to the problem of density fluctuations in stationary homogeneous turbulence in an inviscid compressible fluid. On the basis of the assumptions that the fourth order correlation is related to the second order correlations in the same manner as in a joint Gaussian distribution, and that the variations in density and pressure are adiabatic, a differential equation in the density correlation is obtained and solved. It is found that each scale of the density fluctuation varies periodically with time independently of the others and is propagated through the medium with velocity

$$\sqrt{C^2 + \tfrac{1}{3}u^2}.$$

An invariant of the type of Loitsiansky Invariant is also deduced from the equation of continuity.

532.5

6762 CAVITY FORMATION IN SIMPLE PIPES DUE TO RUPTURE OF THE WATER COLUMN. B.B.Sharp.

Nature (London), Vol. 185, 302-3 (Jan. 30, 1960).

Rapid velocity changes are studied in a 1 in. diameter, 60 ft long copper pipe and the results show that the direct and reflected waves cannot be regarded as independent and must be algebraically summed to find whether the resulting pressure is less than or equal to the vapour pressure. Observations of cavity formation in transparent pipes support the findings. Further work is expected to explain the rupture of the water column and also the growth and the decay of cavities.

T.C.Toye

532.5

6763 AMPLITUDE OF MAINTAINED OSCILLATIONS IN EQUILIBRIUM CHIMNEYS WITH THROTTLING AT THE SECTION LOWER THAN THE LIMITING SECTION OF THOMA.

L.Escande, J.Claria and C.Longerinas.

C.R. Acad. Sci. (Paris), Vol. 249, No. 13, 1069-70 (Sept 28, 1959). In French.

For previous work, see C.R. Acad. sci. (Paris), Vol. 234, 299 and 405 (1952). Empirical values for the amplitudes on rise and fall, obtained from examination of various data, are compared with the corresponding values derived on the assumption of strictly sinusoidal oscillations.

S.Weintroub

532.5 : 550.3

6764 WAVE PROPAGATION IN A LIQUID LAYER. D.T.Liu.

Geophysics, Vol. 24, No. 4, 658-66 (Oct., 1959).

In many areas offshore, the conventional seismic record has the appearance of a series of sine waves or simple odd harmonic combinations of sine waves, with a fundamental wavelength four times the water depth. Burg et al. (1951), in a ray theory treatment, ascribe this oscillatory phenomenon to guided energy travelling in the water layer. A solution of the pressure wave equation for a point source in the water layer has been obtained. It allows one to examine not only the frequency dependence with the depth, but also the transient amplitude response with depth and time. It is concluded that in most actual situations, the phenomenon cannot be wholly explained by the assumed mechanism, because the theory indicates too rapid a decay of the energy.

532.5

6765 THE WAVE IMPEDANCE OF A BODY IN CIRCULAR MOTION. É.A.Perzhnyanko.

Dokl. Akad. Nauk. SSSR, Vol. 130, No. 3, 514-16 (Jan. 21, 1960). In Russian.

A solid body is moving in a horizontal plane along a circular orbit at constant angular velocity within a deep liquid near the surface. Neglecting viscosity, motion of the excited waves is derived: these waves are propagated along circles or spirals. Formulae are given for the wave impedance which is determined by the surface integral of the flow potential.

R.Eisenschitz

532.5

6766 SETTING UP OF LIQUID WAVES OF LARGE AMPLITUDES. Yu.P.Krasovskii.

Dokl. Akad. Nauk SSSR, Vol. 130, No. 6, 1237-40 (Feb. 21, 1960). In Russian.

Author considers waves in a moving, infinitely deep liquid. The liquid velocity at great depths is constant while its free surface follows a steady periodic curve. The problem involves a solution of a non-linear integral equation with a Green type kernal. The method is extended to a liquid placed in a container whose bottom wall is ribbed and the author considers a possibility of the free surface of the liquid having the same periodicity as the bottom wall.

J.K.Skwirzynski

532.5

6767 FLOW MEASUREMENT WITH SUSPENDED-BODY FLOWMETERS. K.Lutz.

Arch. tech. Messen, No. 285 (Ref. V 1247-3), 197-8 (Oct., 1959). In German.

The velocity of flow is measured by the rise of a conical float in the piping. The principle and calibration of the meter and the influence of the density and viscosity of the fluid at high and low Reynolds numbers are discussed.

S.Weintroub

532.5

6768 A NEW METHOD FOR OBTAINING FLOW SIGNALS FROM THE ELECTROMAGNETIC FLOW METER.

C.W.Barnes.

Naturwissenschaften, Vol. 47, No. 3, 56-7 (1960).

The flowmeter is of the type in which the rate of flow of an electrically conductive fluid is determined by measuring the potentia generated between two electrodes at right angles to both the direction of flow and to an alternating magnetic field established across the fluid. The flowmeter is applicable to the measurement of blood flow in arteries. Two voltages are induced between the electrodes: one is in phase with the magnetic flux and is proportional to the instantaneous rate of fluid flow; the other is independent of flow and is in quadrature with the flux. In order to obtain a voltage which is proportional to the fluid flow, the voltages from the electrodes are multiplied by a voltage of constant amplitude and in phase with the magnetic flux. The resulting $2\omega t$ components are eliminated by a low-pass filter. The multiplier consists of four photo-resistors connected in bridge and illuminated by four lamps. The lamps are fed by the constant voltage source. The electrode voltages are applied to one diagonal of the bridge, and the output voltage, which is proportional to flow, is taken from the other diagonal through the low-pass filter. C.F.Pizzey

532.6

6769 CHANGE OF SIZE OF AIR BUBBLES IN WATER CONTAINING A SMALL DISSOLVED AIR CONTENT.

D.M.J.P.Manley.

Brit. J. appl. Phys., Vol. 11, No. 1, 38-42 (Jan., 1960).

The rates of growth and collapse of air bubbles in distilled degassed water are studied. Experimental results show that the effective diffusion coefficient for air through the bubble walls is low at very small bubble diameters. These results are interpreted by the organic skin effect, and the physical qualities of this skin surrounding the bubble walls are discussed.

532.6

6770 VOLUME OF DROPS OF AQUEOUS SOLUTIONS TRANSFERRED TO A SLIDE BY A "MICRO-ROD".

A.E.Hawkins.

Brit. J. appl. Phys., Vol. 10 No. 2, 99-102 (Feb., 1959).

It is shown that it is possible to estimate the volume of aqueous solution transferred by a "micro-rod" from a liquid surface to a clean glass surface. It is shown that if several aqueous solutions are transferred it is possible to estimate the relative proportions of the solutions comprising the mixture on the glass surface.

532.6

6771 METHOD FOR SIZE-DISTRIBUTION DETERMINATIONS OF NON-VOLATILE DROPLETS BY ELECTRON MICROSCOPY.

W.J.Harris.

Brit. J. appl. Phys., Vol. 10, No. 3, 139-40 (March, 1959).

The droplets are sampled on a thin wet film of gelatin solution and washed away when the gelatin has set. Replicas are taken of the impressions left by the spread-out droplets. The replica diameters are converted to droplet diameters by the application of a spread factor which although determined for larger droplets by light microscopy may be reliably applied to droplets in the electron microscope size range.

532.6

6772 A PROPERTY OF THE SPHERICAL APPROXIMATION IN A MINIMUM-ENERGY PROBLEM.

S.Kantorovitz.

Bull. Res. Coun. Israel, Vol. 7F, No. 4, 149-54 (Dec., 1958).
In French.

An assessment is made of the validity of the assumption that a liquid drop on a horizontal plane takes the form of a segment of a sphere. The determination of the drop shape directly (as a minimum-energy problem) is intractable, but, if gravity is neglected, the angle of contact is correctly given by determining the spherical segment of minimum energy. The proportional error in the contact angle so calculated when gravity is not negligible is of the order of drop weight divided by surface tension times free drop radius. J.G.Oldroyd

LIQUID STATE

(Liquid helium is included under Low-Temperature Physics)

532.7

6773 PAIR DISTRIBUTION OF SIMPLE NON-SPHERICAL LIQUIDS.

G.H.A.Cole.

Proc. Phys. Soc., Vol. 75, Pt 1, 77-81 (Jan., 1960).

A procedure is discussed by which the spatial structure of classical simple non-spherical condensed systems (i.e. systems composed of non-spherical particles interacting in pairs) can be determined using the well-established formulae of statistical mechanics without the need to appeal explicitly to vectorial integro-differential equations. In the mathematical method, the effects of particle asymmetry are introduced gradually starting from an appropriate symmetry already known from alternative calculations. The superposition approximation is invoked but its effect may be controlled if necessary. The case of slight molecular asymmetry is the one most conveniently treated although the procedure has a wider usefulness.

532.7 : 539.2

IMPORTANCE OF SYMMETRY IN LIQUIDS. See Abstr. 6004

532.7 : 541.15

APPLICATION OF A HIGH-SPEED ELECTRONIC COMPUTER IN DIFFUSION KINETICS. See Abstr. 6421.

532.7

6774 RELATIONS BETWEEN THE FRICTION CONSTANT AND THE FORCE CORRELATION INTEGRAL IN BROWNIAN MOVEMENT THEORY. A COMPARISON OF THE MICROSCOPIC AND MACROSCOPIC THEORIES.

A.Suddaby and P.Gray.

Proc. Phys. Soc., Vol. 75, Pt 1, 109-18 (Jan., 1960).

Kirkwood's expression for the friction constant in liquids is compared with the expression implicit in Brownian movement theory. Relations between the friction constant β and the fluctuating $F(t)$ are obtained in the case of a white spectrum and of a general spectrum. The former relation resembles Kirkwood's expression and depends on the correlation function of $F(t)$ being sufficiently sharply peaked to permit the integral to reach a plateau value in a time τ_1 such that $\beta\tau_1 \ll 1$. Since Kirkwood's expression involves the total force $X(t) = F(t) - \beta u$, the correlation of this force is calculated in the macroscopic theory of Brownian movement. The infinite integral

$$\int_0^\infty \langle X(t)X(t+\tau)\rangle_t d\tau$$

is found to be zero, but the incomplete integral

$$\int_0^{\tau_1} \langle X(t)X(t+\tau)\rangle_t d\tau$$

is found to be equal to the incomplete correlation integral of the fluctuating force

$$\int_0^{\tau_1} \langle F(t)F(t+\tau)\rangle_t d\tau$$

provided that the upper limit of integration τ_1 is large enough for the correlation function $\langle F(t)F(t+\tau)\rangle_t$ to have decayed to zero, but is sufficiently small to ensure that $\beta\tau_1 \ll 1$. It follows that there is correspondence between the microscopic and macroscopic theories provided this condition holds.

532.7

6775 A STRUCTURAL MODEL FOR MONATOMIC LIQUIDS INCLUDING METALLIC LIQUIDS.

K.Furukawa.

Nature (London), Vol. 184, 1209-10 (Oct. 17, 1959).

A preliminary description of an attempt to correlate some properties of monatomic liquids near the melting point in terms of a "diameter" (A) such that the distance of the first peak of the pair distribution function is $(1.5)^{1/3}$A. It is argued that the average number of "nearest neighbours" is 10.8-90% of the coordination number for the f.c.c. lattice. Estimates are made for activation energies and activation entropies of self-diffusion and of viscosity for 12 liquids. It is concluded, for example, that the activation energy of self-diffusion at constant volume is 1.6 RTm. There is a useful collection of data and references concerning the properties of monatomic liquids. R.O.Davies

532.7

6776 GEOMETRY OF THE STRUCTURE OF MONATOMIC LIQUIDS.

J.D.Bernal.

Nature (London), Vol. 185, 68-70 (Jan. 9, 1960).

This is a preliminary description of a number of model techniques which have been used to simulate the partial order of liquid structures. One technique assigns (by a random process which is not clearly defined) co-ordinates of centres "with the one condition that no two centres should approach at less than a minimum distance". The structure built up in this way is then altered in scale until the potential energy is minimum. The resulting pair distribution function — like that of Morell and Hildebrand (Abstr. 1437 of 1936)

— is similar to that shown for monatomic liquids by X-ray diffraction. More complicated techniques were also used and lead to the concept of an ideal liquid structure defined by the equality of all nearest-neighbour distances. It was found that structures of this type can be built up by combining 5 simple polyhedra, which are illustrated and named; 2 are Platonic and space filling but 3 are Archimedean and not space-filling. It is the latter type that lead to lack of long-range order. R.O.Davies

532.7

6777 STRUCTURE OF GLASS FORMING HALIDES. I. LIQUID BERYLLIUM FLUORIDE. J.D.Mackenzie.

J. chem. Phys., Vol. 32, No. 4, 1150-2 (April, 1960).

Viscosity and electric conductivity measurements were made on liquid beryllium fluoride over the temperature range 700-950° C. The high specific resistance and viscosity and the magnitude of the corresponding energies of activation indicate that the classical random network structure for glasses is applicable. Liquid BeF_2, similar to liquid GeO_2 and SiO_2, is highly associated even at elevated temperatures. At a temperature 200° above the melting point, the energy of activation for viscous flow is greater than the heat of vaporization. The ease of glass formation is attributed to the network structure of the liquid.

532.7

6778 HIGH-TEMPERATURE X-RAY DIFFRACTION STUDY OF MOLTEN SALTS. I. STRUCTURE OF FLUORIDES LiF, NaF AND KF IN THE LIQUID STATE. J.Zarzycki.

J. Phys. Radium, Vol. 18, Suppl. No. 7, 65A-69A (July, 1957).
In French.

The analysis of the radial distribution curves deduced by spherical Fourier transform from the X-ray diffraction spectra of liquid fluorides shows two fundamental facts: (1) the series of first interatomic distances of the crystal (low-range order) is conserved in the liquid state; (2) the coordination numbers of the crystal undergo a very pronounced decrease in the liquid state. This is enough to prove that the structure of molten fluorides is essentially lacunar in nature. It also explains the very high expansion observed on melting of these salts. It is believed that this work provides the first direct experimental proof of the formation of "holes" in molten salts.

532.7

6779 MOLECULAR MOTION OF LIQUID GLYCEROL BY PROTON MAGNETIC RELAXATION.

K.Luszczynski, J.A.E.Kail and J.G.Powles.
Proc. Phys. Soc., Vol. 75, Pt 2, 243-56 (Feb., 1960).

Proton magnetic resonance relaxation times for liquid and supercooled glycerol of low water content have been measured in the temperature range 200°K to 435°K. The spin–lattice relaxation times differ substantially from the earlier measurements. The results are used to deduce correlation frequencies for motion of the glycerol molecules and these are compared with correlation frequencies deduced from dielectric and ultrasonic measurements. Values are now available in the range 10^{-1} to 2×10^{10} c/s which is almost the complete temperature range, glass point to boiling point. Some indication is found that translational molecular motion may be faster than rotational motion in liquid glycerol and possibly dipolar reorientation is faster than that of the whole molecule. Several difficulties in the interpretation are encountered which are no doubt connected with the hydrogen bonding in liquid glycerol. A distribution of correlation frequencies of an extent depending on the temperature is required. The dielectric internal field correction is discussed.

532.7

6780 A RELATION BETWEEN VAPOUR PRESSURE AND COMPRESSIBILITY COEFFICIENT OF LIQUIDS.

R.V.G.Rao and J.C.M.Li.
Z. phys. Chem. (Leipzig), Vol. 213, No. 3-4, 166-76 (1960).

The relation is derived from a consideration of the continuity of states for the process of vaporization, using the virial equation. The agreement of the calculated and observed values is within ±20% for most of the liquids investigated. The application of the equation to condensed gases gives remarkably accurate values. Trouton's constant calculated from this relation agrees well with experiment. A general correlation between vapour pressure and compressibility for liquids is discussed.

532.

6781 VAPOR–LIQUID EQUILIBRIUM OF BENZENE-2,2,4-TRIMETHYLPENTANE MIXTURES.

S.Weissman and S.E.Wood.
J. chem. Phys., Vol. 32, No. 4, 1153-60 (April, 1960).

The vapour–liquid equilibria were measured at 10 deg interval from 35 to 75° over the entire range of composition. The excess thermodynamic functions have been calculated from these data for the processes of mixing at constant pressure and at constant volum All these functions are positive over the whole range of compositio and decrease with increase of temperature. The behaviour of this system is in qualitative agreement with the predictions of theory.

532.

6782 MAXIMUM OF THE SOLUBILITY IN A LIQUID OF A COMPONENT OF A GASEOUS MIXTURE.

A.Yu.Namiot.
Dokl. Akad. Nauk SSSR, Vol. 130, No. 2, 359-61 (Jan. 11, 1960).
In Russian.

The equilibrium of a gaseous methane–propane mixture with liquid water is considered in some detail. At 40° C and at pressure up to 90 atm the solubility of propane as plotted against the pressure shows a maximum and a minimum. The thermodynamical conditions for the appearance of extreme values of solubility are discussed. The peculiar properties of the above mixture derive from the fact that the partial mole volume of propane in the gaseou mixture is smaller than its partial mole volume in the liquid mixture and also its mole volume in the liquid state. R.Eisenschit

532.

6783 MAYER'S IONIC SOLUTION THEORY APPLIED TO ELECTROLYTE MIXTURES. H.L Friedman.

J. chem Phys., Vol. 32, No. 4, 1134-49 (April, 1960).

For solutions of a mixture of two electrolytes with a common ion, the characteristic free energy function is $\Delta_m G^{ex}$, the change in excess free energy on forming the solution from solutions of the single electrolytes. This is closely related to $\Delta_m S$, where S is the cluster integral sum of the Mayer theory. For systems that conform to Harned's rule the contributions of most of the cluster integrals to $\Delta_m S$ are negligible. The form of the principle contribution to $\Delta_m S$ depends on whether the two electrolytes have the same charge type (symmetrical mixtures) or not. The equations fo symmetrical mixtures which nearly conform to Harned's rule are developed in detail, first for the general case in which the components of the potential of average force are arbitrary and then for th special case of hard sphere ions, designated as the primitive model for electrolyte solutions. The leading term of $\Delta_m S$ is determined by the difference in short-range interaction of pairs of ions of the same charge and does not depend at all on the common ions. Anoth general result is that $\Delta_m G^{ex}/I^2$ does not vanish as $I \to 0$, as has some times been expected on the basis of the Brønsted principle of specif ion interaction, but approaches a finite value in a way that is gover by a higher-order limiting law. Comparison with experiment is made on the basis of the primitive model. The results are roughly consistent with the free energy effects in alkali metal chloride mixtures if it is assumed that the effective radii of the alkali metal ion are about double their crystal radii.

532.

6784 THERMAL DIFFUSION IN SOLUTIONS OF ELECTROLYTES. J.N.Agar and J.C.R.Turner.

Proc. Roy. Soc. A, Vol. 255, 307-30 (April 16, 1960).

A conductimetric method for following the small concentration changes that occur when a temperature gradient is maintained in a aqueous electrolyte is described. The solution is contained in a Perspex cell between silver end-plates which are faced with platinized platinum and kept at temperatures differing by about 10° C. A further connection to the cell (a "centre-tap") is made through a small lateral hole equidistant from the ends. The cell is incorporated in an audio-frequency Wheatstone bridge and movement of solute from one half of the cell to the other is followed by measuri the ratio of their resistances. For a convection-free system, the Soret coefficient (σ) may be derived either from the initial rate of change of the ratio or from its value in the steady state. It is foun experimentally that there are discrepancies between the two estimates of σ, and also related anomalies in the rate of change of co centration, which can be ascribed to convection. It can be shown that the initial rate observations should be free from convection errors, and the effect of convection on the steady state can be analysed by dimensional methods. The observed discrepancies are correlated with the relevant properties of the solutions in the manner suggested by this analysis. The Soret coefficients of eighteen 1 : 1 salts in 0.01 M aqueous solution and at mean temperature 25.0° C were determined by this method. Some additional measurements have been made at 34.7° C and at other concentrations in the range 0.002 to 0.02 M. Three salts of other valency types (potassium, thallous and cadmium sulphates) were also studied. The molar heats of transport of the salts (Q*) have been calculated from the Soret coefficients. The results show that Q* (i) is an additive function of contributions characteristic of the constituent ions in dilute (0.01 M) solutions of 1 : 1 electrolytes; (ii) increases markedly on raising the mean temperatures from 25.0 to 34.7° C, in agreement with the results of other workers; (iii) increases appreciably on dilution below 0.01 M, indicating that heats of transport are influenced by long-range inter-ionic forces

532.7

6785 THERMO-MAGNETIC EFFECTS IN LIQUIDS.

R.C.Saxena, J.N.Tandon and S.P.Talwar.

Nature (London), Vol. 185, 158-9 (Jan. 16, 1960).

Curves now presented for the rates of cooling of mercury and water in a magnetic field (and normally), indicate both rates to be faster than when no field is present, and that those for mercury are the steeper. Also, the rates of heating are enhanced for both liquids by a high magnetic field (~ 23 000 Oe). Suggested explanations are changes in specific heat or of absorptivity (or emissivity) produced by the magnetic field. In the case of mercury there may be some additional effect due to the inhibition of convection in the magnetic field. H.H.Hodgson

532.7 : 536.22

THERMAL CONDUCTIVITY OF MONATOMIC DIELECTRIC LIQUIDS.

See Abstr. 5206

532.7

6786 SOUND VELOCITIES IN BINARY LIQUID MIXTURES.

H.Singh and R.S.Seth.

Ann. Phys. (Leipzig), Folge 7, Vol. 5, No. 1-2, 53-6 (1959).

Five binary mixtures of toluene—carbon tetrachloride, benzene—hexane, cyclohexane—carbon tetrachloride, hexane—toluene and benzene—carbon tetrachloride at various concentrations were measured by the Debye—Sear's diffraction method. It is found that the velocity and compressibility vary approximately linearly with concentration. Comparison between experimental and theoretical results shows fairly good agreement.

532.7 : 534.21

6787 THEORY OF ULTRASONIC VIBRATION POTENTIALS IN PURE LIQUIDS.

A.Weinmann.

Proc. Phys. Soc., Vol. 75, Pt 1, 102-8 (Jan., 1960).

Various possible mechanisms, which could produce potentials in a pure liquid through which an ultrasonic wave is propagating, are discussed. Alignment of molecular dipoles, due to density gradients, appears to be the most effective mechanism, and could account for the potentials observed in polar liquids. It is suggested that the non-polar heptane (and the similar paraffins of this series) really contain weak quasi-free dipoles, whose moment is of order 0.2×10^{-18} e.s.u. cm. This could account for the small potentials which have been observed in heptane by Rutgers and Rigole (1958).

532.7

6788 ULTRASONIC ABSORPTION IN ETHYL ACETATE.

E.F.Carome and S.R.Burlage.

J. Acoust. Soc. Amer., Vol. 32, No. 4, 510-11 (April, 1960).

Measurements of ultrasonic absorption in ethyl acetate in the range 2 to 20 Mc/s indicate that the relaxation frequency below 10 Mc/s reported by various investigators is spurious and probably due to diffraction effects.

532.7

6789 ULTRASONIC VELOCITY IN SUPERCOOLED LIQUIDS.

A.Barone, G.Pisent and D.Sette.

Acustica, Vol. 7, No. 2, 109-12 (1957).

A high precision interferometer was used to study menthol, m-chlornitrobenzene, diphenylether and salol, in the normal and supercooled states. In both regions, the temperature dependence of velocity is linear for all compounds. The temperature coefficient (absolute value) is however, larger in the supercooled liquids than in the normal ones for menthol, diphenylether and m-chlornitrobenzene. In salol, the temperature coefficient is practically the same in the two regions, but it takes considerably smaller values in a narrow temperature range in the transition from the normal to the supercooled liquid. These results agree with those obtained by means of viscosity measurements and suggest that the structural variations which take place in the transition region between normal and supercooled liquids are mainly due to the formation of molecular associations.

532.7

6790 ULTRASONIC VELOCITIES IN AQUEOUS SOLUTIONS OF CADMIUM IODIDE AND MERCURIC CHLORIDE.

S.V.Subrahmanyam.

Nature (London), Vol. 185, 371 (Feb. 6, 1960).

The ultrasonic (750 kc/s) velocity was found to decrease with increasing concentration. A lowering of 140 m/sec at 1.75 M of CdI and 18 m/sec at 0.25 M of $HgCl_2$ was observed. J.Jarzyński

532.7 : 534.21

6791 ULTRASONIC RELAXATION IN LIQUID METHYLENE CHLORIDE.

J.H.Andreae, P.L.Joyce and R.J.Oliver.

Proc. Phys. Soc., Vol. 75, Pt 1, 82-6 (Jan., 1960).

In order to answer the question left open by a previous publication ultrasonic measurements have been made in liquid methylene chloride at −22° C. These confirm that there is a relaxation of the vibrational specific heat less the contribution of the lowest frequency mode of vibration. The paper ends with a short discussion of some hypersonic measurements recently reported by Pesin and Fabelinskii (Abstr. 127 of 1960).

532.7

6792 THE DETERMINATION OF THE CONSTANTS OF THE RELAXATION MECHANISM IN $MnSO_4$ SOLUTIONS AT VARIOUS TEMPERATURES AND CONCENTRATIONS.

I.Ertas.

Rev. Fac. Sci. Univ. Istanbul C, Vol. 23, No. 3-4, 210-28 (July-Oct., 1958).

Using a pulse method, the difference of sound velocities at 0.8 and 2.4 Mc/s in $MnSO_4$ solutions of 0.25, 0.5, 1.0 and 2.0 mol/litre concentration was measured between 10° and 40° C. Also the difference between the absorption coefficients of the solution and of water was determined at 2.4 Mc/s. Assuming one relaxation mechanism, the two constants of the Kneser formula are calculated. It is found that the relaxation frequency increases with temperature and concentration. The maximal relative dispersion is not proportional to the concentration, but reaches its highest value at about 1 mol/litre. Using these calculated constants, the values of the relative dispersion at 5 and 15 Mc/s are calculated and compared with the values given by Carstensen and Tasköprülü. It is found that for 0.5 mol/litre the agreement is good, whereas for higher concentrations the deviation is greater than the limits of error.

532.7

6793 ON THE VARIATION OF COMPRESSIBILITY OF WATER AND ELECTROLYTIC SOLUTIONS WITH TEMPERATURE.

P.Kumar Mahapatra and B.Charan Ray.

Indian J. Phys., Vol. 32, No. 9, 439-42 (Sept., 1958).

Ultrasonic velocities and compressibilities in water and some electrolytes have been measured. The results have been discussed in the light of the knowledge about their structures.

532.7 : 539.2

6794 MEASUREMENTS OF ATOMIC VELOCITY DISTRIBUTIONS IN Hg AND HgO BY THE NUCLEAR RESONANT SCATTERING OF GAMMA RAYS.

D.C.Champney and C.A.Miller.

Proc. Phys. Soc., Vol. 74, Pt 6, 680-4 (Dec., 1959).

With a technique based on the nuclear resonant scattering of gamma rays, the thermal velocity distributions of the mercury atoms in mercury at 296°K (liquid) and in mercuric oxide at 77°K (solid) have been measured. In agreement with theoretical predictions, the distributions are found to be Maxwellian in shape but corresponding to a distribution appropriate to an effective temperature higher than the actual one.

532.7 : 539.12

6795 LOW-TEMPERATURE NEUTRON MODERATION.

L.B.Borst.

Phys. Rev. Letters, Vol. 4, No. 3, 131 (Feb. 1, 1960).

Discusses the results of Hughes et al. (Abstr. 80 of 1960), concerning the inelastic scattering of 0.005 eV neutrons. It is concluded that the ortho—para transition of hydrogen in water will account for the occurrence of the two satellite lines observed. From the observations of Hughes et al. it is estimated that the inelastic cross-section for $HO_{1/2}$, at room temperature, is 8 barns.

A.J.Salmon

532.7 : 537.2 : 621.317.37

6796 METHOD FOR MEASURING THE COMPLEX DIELECTRIC CONSTANT OF A HIGH-LOSS LIQUID AT 8 mm WAVELENGTH. E.H.Grant.

Brit. J. appl. Phys., Vol. 10, No. 2, 87-9 (Feb., 1959).

A method specifically suited to the investigation of liquids exhibiting high dielectric constant and high loss at 8 mm wavelength is described. Conventional techniques for measuring wavelength in the liquid and attenuation coefficient have been adapted for this purpose, and a feature of the method is the use of the same experimental cell for both reflection and absorption measurements. The measured value for the complex dielectric constant of water at 25°C is in close agreement with theory.

532.7 : 537.2

6797 TEMPERATURE DEPENDENCE OF DIELECTRIC CONSTANT. W.Dannhauser.

Z. phys. Chem. (Leipzig), Vol. 213, No. 3-4, 225-30 (1960).

The temperature dependence of the dielectric constant of several polar liquids, including water, is analysed in terms of molecular parameters using an equation derived by Kirkwood. Particular attention is given to the following terms which may vary with temperature, viz. molecular dipole moment, density and correlation factor.

A.E.Kay

532.7 : 537.2 : 533.7

6798 ON THE MOLECULAR THEORY OF THE KERR EFFECT. P.Mazur and B.J.Postma.

Physica, Vol. 25, No. 4, 251-67 (April, 1959).

A general statistical mechanical formalism previously developed for discussion of the dielectric properties of fluid systems, is applied to the treatment of the Kerr effect. The systems considered consist of identical, non polar, anisotropic molecules. A formal expression can be obtained for the Kerr constant. This expression may be expanded in a double power series in the polarizability tensor and the density of the medium. Explicit expressions are given for the lowest order terms of this expansion.

532.7 : 537.2

6799 DESCRIPTION OF AN APPARATUS FOR THE PRECISE MEASUREMENT OF DIELECTRIC CONSTANTS OF LIQUIDS. H.Lumbroso and P.Rossetti.

J. Chim. phys., Vol. 56, No. 10, 844-9 (Oct., 1959). In French.

An apparatus is described for the measurement of dielectric constant to 0.0002 of dilute solutions at 1 Mc/s for the determination of electric dipole moments. A classical heterodyne beat method is used but the cell is of novel design.

J.G.Powles

532.7 : 537.2

6800 CONDUCTION CURRENTS IN LIQUID N-HEXANE UNDER MICROSECOND PULSE CONDITIONS.

A.H.Sharbaugh and P.K.Watson.

Nature (London), Vol. 184, 2006-7 (Dec. 26, 1959).

Describes measurements of pre-breakdown currents. No evidence of an α-process was found for fields below 1.25 MV/cm although there were possible indications of such a process for only slightly higher fields. Large current densities ($\sim 10^{-2}$ A/cm^2) were found and since these were localized at "points" on the cathode, the local energy dissipation could be $\sim 10^7$ W/cm^3. It is suggested that bubbles, previously thought to be involved in liquid breakdown, could then be produced by rapid vaporization.

J.D.Craggs

532.7 : 537.2

6801 EFFECT OF THE BRANCHING ON DIELECTRIC PROPERTY OF POLYVINYL ACETATE SOLUTION.

I.Murakami, N.Isshiki and H.Yamamura.

J. Sci. Hiroshima Univ. A, Vol. 23, No. 2, 257-62 (Dec., 1959).

The effect of the degree of polymerization and branching in polyvinyl acetate solution upon its flow has been clarified through viscosity measurements. Dielectric studies on polyvinyl acetate (PVAc) solution have revealed that the dielectric constant in PVAc solution is not related to the degree of polymerization and have explained that the dielectric behaviour of the polymer is quite similar to that of any corresponding assembly of the structual units of the polymer. As the dielectric studies so far have not specified the effects of branching, samples with diverse degrees of branching were prepared, and the respective dielectric constants of their benzene solutions measured in the frequency range of 0.3-1000 kc/s.

532.7 : 537.2

6802 DIELECTRIC STUDIES ON DEOXYRIBONUCLEIC ACID H.G.Jerrard and B.A.W.Simmons.

Nature (London), Vol. 184, 1715-16 (Nov. 28, 1959).

The dielectric constant of purified, salt-free D.N.A. was measured over the frequency-range 30 kc/s to 10 Mc/s. Three concentrations, (1) 460, (2) 230, (3) 92 mg/l. respectively, were studied and from the results the dielectric increments per g/l. were calculated to be 54.3, 31.3 and 19.8 respectively. On the basis of the Debye concept of dielectric properties it is estimated that the molecular weights are 0.16×10^6, 0.25×10^6 and 0.43×10^6 for the three concentrations. These values cast doubt on the applicability of Debye's theory that the molecules rotate in their entirety. The streaming dielectric effect shows that dielectric constant decreases with increasing flow gradient. Experiments were also carried out on the effect on dielectric constant and on viscosity of heating solutions with, and without, 0.2 M NaCl. On the Debye theory the results would seem to indicate that the mol. wt. of D.N.A. is unchanged when heated to 100°C for 15 min in salt solution but is reduced by a factor of 8 when heated in the absence of salt.

J.Iball

532.7 : 537.2 : 539.2

6803 DIELECTRIC PROPERTIES OF γ-RAY IRRADIATED METHYL-METHACRYLATE AND POLYMETHYL-METHACRYLATE. Y.Inuishi, H.Sumitomo and K.Hayata.

Technol. Rep. Osaka Univ., Vol. 8, 243-51 (Oct., 1958).

The effects of γ-irradiation from Co^{60} on M.M.A. and P.M.M.A. were studied experimentally. Purified M.M.A. monomer was polymerized by γ-ray irradiation. The breakdown strength of M.M.A. sample increases abruptly at the dosage where the transition from liquids to solids occur. These effects are ascribed to the suppression of ionic space charge and bubble formation due to abrupt increase in the viscosity. Prebreakdown current seems to be mainly ionic. The breakdown, however, seems to be the result of electronic current multiplication. P.M.M.A. resin degrades by γ-irradiation to smaller mean molecular weight. D.C. and impulse breakdown strength decrease, and conduction current increase by these degradation. Ionic model of conduction was proposed. The lowering of d. breakdown voltage due to γ-ray irradiation seems to be result of increased ionic space charge and local heating. The lowering of impulse breakdown strength, however, necessitates some electronic model. Introduction of an impurity electron level of π electrons by degradation was proposed as an explanation.

532.7 : 535.33

6804 ULTRAVIOLET ABSORPTION SPECTRA OF SOLUTIONS OF PYRIDINE IN DIFFERENT SOLVENTS AND AT DIFFERENT TEMPERATURES. S.B.Roy.

Indian J. Phys., Vol. 32, No. 7, 323-9 (July, 1958).

The ultraviolet absorption spectra of solutions of pyridine in cyclohexane, 3-methyl pentane, carbon tetrachloride and isobutyl alcohol have been studied and the results have been compared with those for the vapour reported by previous workers. The two systems of bands due respectively to $n \rightarrow \pi^*$ and $\pi \rightarrow \pi^*$ transitions are observed in the spectra due to solutions in cyclohexane, 3-methyl pentane and carbon tetrachloride, but the first system is totally absent in the spectrum of the solution in isobutyl alcohol. The inter val between the successive bands in the first system is 542 cm^{-1}, which agrees closely with that observed in the case of the vapour. It has further been observed that the 0, 0 band in the first system shifts by about 430 cm^{-1} when pyridine is dissolved in the first thre solvents. It is pointed out that these results confirm the explanation put forward by previous workers for the absence of the first system of bands in the case of the solution in alcohol. The $n \rightarrow \pi^*$ transition does not occur in this case because a bond is formed between the pyridine molecule and the alcohol molecule through the non-bonding electron of the nitrogen atom, but no such bond formation takes plac in the solutions in the other solvents.

532.

6805 CRITICAL OPALESCENCE OF POLYSTYRENE SOLUTIONS. P.Debye, H.Coll and D.Woermann.

J. chem. Phys., Vol. 32, No. 3, 939-40 (March, 1960).

Debye (Abstr. 12073 of 1959) has derived a relationship for the intensity of scattered light measured at any angle θ with respect to the incident beam in terms of the ambient temperature, the critical temperature, the wavelength and l, where l is the average range forces between component molecules. The validity of this rela- nship has been established by Debye for a system of small mole- es. This note gives the results of an investigation with a poly- rene—cyclohexane solution of number average molecular weight n) 147 000. The ratio of weight average molecular weight to M_n 1.04. Qualitative agreement was found with the Debye relation- p but the experimental value of l was appreciably less than that culated from theory. H.G.Jerrard

532.7 : 535.37

6806 ENERGY TRANSPORT IN LUMINESCENT SOLUTIONS. I.

H.K.Bothe.

n. Phys. (Leipzig), Vol. 5, No. 5-6, 339-52 (1960). In German.

The Kallmann-Furst relations for dependence of luminescence solute concentration (See Abstr. 224 of 1951) are generalized to ply to solid solutions in polystyrene. From characteristic fferences between the intensity versus concentration relations for quids and solids conclusions can be drawn about the detailed mechan- m of energy transfer between solvent and solute. G.F.J.Garlick

532.7 : 535.37 : 539.19

ABSORPTION AND PHOSPHORESCENCE SPECTRA OF THE ONO- AND DI-AZANAPHTHALENES. π—π PHOSPHORESCENCE FTER n—π ABSORPTION IN DI-AZANAPHTHALENES.

e Abstr. 5949

532.7 : 535.37

6807 ON THE SENSITIZED FLUORESCENCE OF MIXED SOLUTIONS.

I.Ketskeméty.

ta phys. Hungar., Vol. 10, No. 4, 429-39 (1959). In German.

The phenomenological theory of secondary fluorescence (Abstr. 4 of 1951) is generalized for the case of the sensitized fluores- nce of mixed solutions. The kinetic equations for energy transfer tween two different kinds of solute molecules are developed. ese are used to interpret the spectrophotometric studies on mixed ute systems of trypaflavin and rhodamine B. G.F.J.Garlick

532.7 : 535.37

6808 TRANSFER OF EXCITATION ENERGY AND RADIATIONLESS TRANSITIONS.

M.Furst and H.Kallmann.

chem. Phys., Vol. 31, No. 4, 1134-5 (Oct., 1959).

It is proposed that non-radiative energy transfer between solvent d solute molecules in fluorescent organic solutions is not accom- nied by solute quenching of the solvent excitation energy. J.B.Birks

532.7 : 535.37

6809 TRANSFER OF EXCITATION ENERGY AND RADIATIONLESS TRANSITIONS: REPLY TO COMMENTS BY URST AND KALLMANN.

J.B.Birks.

chem. Phys., Vol. 31, No. 4, 1135-6 (Oct., 1959).

See preceding abstract. The experimental data on the maximum alues of the solvent—solute energy transfer coefficient in organic olutions are tabulated, and it is proposed that in some systems here the maximum coefficient is less than unity, solute quenching ompetes with the energy transfer. J.B.Birks

532.7 : 535.37

6810 DECAY OF PHOTOLUMINESCENCE OF SOLUTIONS.

A.Jabłoński.

cta phys. Polon., Vol. 16, No. 6, 471-9 (1957).

One factor which may cause the decay to deviate from a simple xponential law is the change produced by neighbouring like mole- ules of the probability of transition involved in the emission of hosphorescence. Such changes occur in certain organosphosphors. The model of a luminescent centre adopted in the present paper is he simplest one, and it is believed that the results it yields may be ood approximations, even in the case in which the centres are in eality complexes of very loosely bound luminescent molecules utually oriented at random. Expressions are obtained describing he decay and the decay time dependence on the luminescence olarization.

532.7 : 535.37

6811 THE FLUORESCENCE SPECTRUM OF NAPHTHALENE SOLUTION IN OCTODEUTERONAPHTHALENE AT 20°K.

.Pesteil and A.Ciais.

.R. Acad. Sci. (Paris), Vol. 250, No. 3, 494-6 (Jan. 18, 1960).
n French.

A table of 26 lines is given between 31561 and 31526 cm^{-1} (the doublet due to the pure electronic transition) and 28296 cm^{-1}, with their attributions to combinations of the doublet with symmetrical vibration frequencies. S.T.Henderson

532.7 : 535.37

6812 THE FLUORESCENCE SPECTRA OF NAPHTHALENE AND OF OCTODEUTERONAPHTHALENE SOLUTIONS IN PENTANE AT 20°K.

L.Pesteil.

C.R. Acad. Sci. (Paris), Vol. 250, No. 3, 497-9 (Jan. 18, 1960).
In French.

The pure electronic transition in $C_{10}H_8$ produces a doublet at 31734 and 31771 cm^{-1}, and at 31860 and 31899 cm^{-1} in $C_{10}D_8$. About 40 lines for each compound are compared and their vibrational components assigned. Values of the vibrational frequencies used are compared with those of other authors (Abstr. 2601, 2946 of 1955; 1064 of 1956). S.T.Henderson

532.7 : 538.2

6813 THE THEORY OF MAGNETIC BIREFRINGENCE AND OTHER PHENOMENA OF MOLECULAR ORIENTATION IN DIAMAGNETIC LIQUIDS.

A.Piekara and S.Kielich.

J. Phys. Radium, Vol. 18, No. 8-9, 490-7 (Aug.-Sept., 1957).

The molar constant of magnetic birefringence and those of other molecular orientational effects have been calculated: electric birefringence, dielectric, polarization, electric saturation of the dielectric polarization, electric saturation of the dielectric polarization or effect of the electric field on the dielectric permittivity, and, finally, magnetic saturation of the dielectric polarization or effect of the magnetic field on the electric permittivity. It was assumed that the molecules are anisotropic with regard to their optical, electric and magnetic properties and are subject to the interaction of the surrounding molecules. Without making any assumption on the nature of the intramolecular forces and the shape of the molecules general formulae are obtained, the sole assumption being that the molecules may be considered to have rotational symmetry. On the basis of these formulae it is possible to relate the variation $\Delta\epsilon^{m}_{sat}$ of the dielectric permittivity resulting from the effect of the magnetic field to the Cotton—Mouton and Kerr constants. The relation obtained makes a prediction of $\Delta\epsilon^{m}_{sat}$ possible providing the local field acting upon the molecule is known. Assuming the Lorentz field or the Onsager field, values of $\Delta\epsilon^{m}_{sat} = 5 \times 10^{-5}$ and 2×10^{-5} respectively are obtained for nitrobenzene in a magnetic field of 40 kOe. In particular, assuming that the intramolecular forces are due mainly to the molecule momentarily nearest to the one considered (pair coupling), and assuming the flattened or elongated form of molecules yielding minimum potential energy at parallel or antiparallel array of the molecular dipoles respectively, the same formulae are obtained as before. According to these formulae, the molar Cotton—Mouton constant of nitrobenzene, when dissolved in a non-polar solvent, rises rapidly with the concentration, whereas the electric saturation of the dielectric polarization changes its sign, becoming positive. These are, in fact, the two effects experimentally observed.

532.7 : 538.27

6814 PARAMAGNETISM OF RADIOACTIVE SOLUTIONS.

V.M.Vdovenko and V.A.Shcherbakov.

Dokl. Akad. Nauk SSSR, Vol. 127, No. 1, 127-30 (July 1, 1959).
In Russian.

A modified Pound—Knight spectrometer (Abstr. 5941 of 1950) was used for determining the relative changes of spin—lattice relaxation T_1 of water protons in the investigation of magnetic properties of aqueous solutions irradiated either by dissolved radio-isotopes or by external β and γ-sources The method applied was analogous to that used by Kozyrev and Rivkind (Abstr. 1055 of 1955). It was found that the presence of (internal or external) radioactivity in a solution causes a reduction of T_1, which, in the case of external sources, does not change appreciably during several days. The authors believe that the observed effect is related to the formation of paramagnetic particles as a result of the radiolysis of solutions. F.Lachman

532.7 : 538.27

6815 THE OVERHAUSER—ABRAGAM EFFECT IN THE $(SO_3)_2\,NO^{=}$ RADICAL IN INTERMEDIATE MAGNETIC FIELDS.

W.Müller-Warmuth and P.Parikh.

Z. Naturforsch., Vol. 15a, No. 1, 86-7 (Jan., 1960). In German.

Reports measurements of proton resonance signal enhancement for the saturation of the various hyperfine electron spin resonance lines of $(SO_3)_2\,NO^{2-}$ in solution in water in a magnetic field of 11.7 G, which is intermediate for the hyperfine interaction. J.G.Powles

532.7 : 538.27

6816 NUCLEAR SPIN—LATTICE RELAXATION TIME AND THE ELECTRIC INTERNAL FIELD IN POLAR LIQUIDS. J.W.Hennel.
Acta phys. Polon., Vol. 18, No. 4, 387-9 (1959).

The intrinsic dielectric relaxation time is derived from the proton spin lattice magnetic resonance relaxation time for water in the temperature range 0-75°C. The results are compared with the macroscopic dielectric relaxation time (Abstr. 963 of 1948). The relation between the two times supports a theoretical prediction of Powles. J.G.Powles

532.7 : 538.27

6817 NUCLEAR MAGNETIC RELAXATION OF PROTONS IN LIQUID. I. GROWTH EFFECTS IN NUCLEAR MAGNETIC RESONANCE ABSORPTION. Su. Nakamura.
J. Sci. Hiroshima Univ. A, Vol. 23, No. 2, 215-49 (Dec., 1959).

It has already been reported [Nakamura, Journal of Kagoshima University, Vol. 6, No. 19 (1957)] that when nuclear magnetic resonance absorption of proton in liquid is observed on the oscilloscope by means of Pound-Knight's spectrometer (see Abstr. 5941 of 1950) a certain time is required before the magnitude of absorption reaches the stationary value and that the time is roughly equal to the spin-spin relaxation time of a sample. The present paper presents the detailed analysis of the effect using the Bloch equation, and a comparison with experimental results is made. The conclusions are: (i) when a resonance state is realized by flipping the magnetic field, the absorption signal on the c.r.o. screen grows with a form of $(1 - e^{-t/T_1})$, (ii) and when brought by flipping the frequency of the spectrometer, the absorption pattern grows in the form of $(1 - Ae^{-t/T_2})$. One method of flipping the magnetic field is to put the sample quickly into the magnetic field. If the above result is employed, it is possible to measure the approximate value of T_1 and T_2 in a simple way.

532.7 : 538.27

6818 NUCLEAR MAGNETIC RELAXATION OF PROTONS IN LIQUID. SUPPLEMENT OF PART I. APPLICATION OF JAYNES THEORY TO THE GROWTH EFFECTS IN NUCLEAR MAGNETIC RESONANCE. Su. Nakamura.
J. Sci. Hiroshima Univ. A, Vol. 23, No. 2, 251-6 (Dec., 1959).

532.7 : 538.27

6819 NMR STUDY OF ACETALDEHYDE—WATER MIXTURES. E.Lombardi and P.B.Sogo.
J. chem. Phys., Vol. 32, No. 2, 635-6 (Feb., 1960).

Comparison of the intensities of high resolution proton spectra attributed to hydrated and non-hydrated acetaldehyde molecules respectively, yields an equilibrium constant for the hydration process in agreement with values previously obtained by calorimetric and spectrophotometric methods. E.F.W.Seymour

MECHANICS OF GASES

533.1

6820 VISCOSITY OF BINARY MIXTURES OF HYDROGEN ISOTOPES AND MIXTURES OF He AND Ne.
A.O.Rietveld, A.van Itterbeek and C.A.Velds.
Physica, Vol. 25, No. 3, 205-16 (March, 1959).

The coefficient of viscosity of mixtures H_2—HD, H_2—D_2, HD—D_2 and He—Ne has been determined, using the method of the oscillating disk at 293, 230, 195, 90, 70, 20 and 14°K and at different concentrations. The results are compared with the results calculated from a Lennard-Jones potential and the appearing differences are discussed.

533.4

6821 HIGH PRESSURE MANOMETER. H.H.Reamer and B.H.Sage.
Rev. sci. Instrum., Vol. 31, No. 3, 337-41 (March, 1960).

A manometer which measures differential pressures involving a total head of as much as 1 atm with a precision of 0.002 in. Hg is described. The calibration of the manometer is relatively insensitive to pressure and does not involve any direct or indirect means of visual observation of the mercury—fluid interface. Application of the instrument is limited to fluids which do not react with mercury.

533.6 : 551.

6822 A GENERALIZATION OF THE MIXING-LENGTH CONCEPT. J.A.Businger.
J. Meteorol., Vol. 16, No. 5, 516-23 (Oct., 1959).

A concept for the mixing length in diabatic conditions is introduced and elaborated. The basic idea is that convective energy has effect on the mixing length but not on the size of the largest eddies. The theory developed on this concept of the mixing length for the diabatic wind profile gives satisfactory agreement with observation over a wide stability range.

533.

6823 A RAPIDLY CONVERGENT PROCEDURE FOR SOLVIN THE EQUATIONS OF SUBSONIC POTENTIAL FLOW. I. NUMERICAL SOLUTIONS. A.B.Tayler.
Proc. Roy. Soc.A, Vol. 255, No. 1280, 101-13 (March 22, 1960).

The subsonic potential flow equations for a perfect gas are transformed by means of dependent variables $s = (\rho/\rho_0)^n q/a_0$ and $\sigma = \frac{1}{2} \ln (\rho_0/\rho)$, where q is the local velocity, ρ and a the local de sity and speed of sound, and the suffix 0 indicates stagnation conditions. n is a parameter which is to be chosen to optimize the approximations. Bernoulli's equation then becomes a relation betwee s^2 and σ which is independent of initial conditions. A family of first-approximation solutions in terms of the incompressible soluti is obtained on linearizing. It is shown that for two-dimensional flow, the choice n = 0.5 gives results as accurate as those obtained with the Karman—Tsien solution. The exact equations are then tra formed into the plane of incompressible velocity potential and stream function and the first-approximation results substituted in t nonlinear terms. The resulting second-approximation equations ca then be solved by a relaxation method and the error in this approxi mation estimated by carrying out the third-approximation solution. Results are given for a circular cylinder at a free-stream Mach number, $M_\infty = 0.4$, and a sphere at $M_\infty = 0.5$. The error in the velo city distribution is shown to be less than ± 1% in the two-dimension case. A rough-and-ready compressibility rule is formulated for axisymmetric bodies, dependent on their thickness ratios.

533

6824 A RAPIDLY CONVERGENT PROCEDURE FOR SOLVIN THE EQUATIONS OF SUBSONIC POTENTIAL FLOW. II. ANALYTIC SOLUTIONS. A.B.Tayler.
Proc. Roy. Soc. A, Vol. 255, No. 1280, 114-23 (1960).

This is a continuation of Pt I (see preceding abstract) which ob tained a second approximation to the subsonic potential flow equations. Results were obtained numerically for a circular cylinder and were shown to have an error of less than 1% in the velocity distribution at free-stream Mach numbers near the lower critical. In this paper by making a further approximation an analytic solutio of these second-approximation equations is obtained, valid for all two-dimensional bodies for which the conformal transformation of their cross-section into a circle is known. Results are obtained fo a circular cylinder and compared with those obtained numerically. The two sets of results are not significantly different. Results are also obtained for Kaplan's aerofoil and a circular cylinder with circulation. A detailed comparison is made with existing methods solution, together with a discussion of the advantages of both the analytic and numerical methods of these two papers. Solutions are obtained in the lower transonic region, but no attempt has been ma to prove the convergence of the method.

533.6 : 5

COMPUTATION OF THE SUPERSONIC FLOW OVER A DELT SHAPED BODY. See Abstr. 6539

533

6825 EFFECT OF FLOW PULSATIONS ON THE DRAG OF BAFFLES IN PIPES. M.Cox and F.J.Bayley.
J. mech. Engng Sci., Vol. 2, No. 1, 16-24 (March, 1960).

Describes two complementary investigations into the factors affecting the pressure loss across flame-stabilizing baffles. In th first, a series of tests made under "cold" and burning conditions is reported, and it was found that except when very high rates of heat release were utilized, observations made in the cold and burn tests were compatible. It was suggested that the large increases loss observed in certain cases were due to the effects of flow puls tions. The second investigation, made under more controlled conditions, confirms this, and a simple quasi-steady theory of the effects of the pressure fluctuations is found to account wholly for the results obtained.

533.6

6826 APPROXIMATE REPRESENTATION OF A PARTICULAR CLASS OF [PATTERNS OF] UNSTEADY NEARSONIC LOW. O.S.Rýzhov and G.M.Shefter.

okl. Akad. Nauk SSSR, Vol. 130, No. 2, 276-9 (Jan. 11, 1960). Russian.

Flow of a gas through a Laval nozzle is considered. In analogy known expressions for the velocity in stationary flow corresonding expressions for non-stationary, near-sonic flow are put rward which take account of the presence of supersonic flow over mited regions. According to the theory there is no discontinuity f density. This aspect of the theory is, however, not strictly comatible with the constraint due to the fixed shape of the nozzle.

R.Eisenschitz

533.6 : 551.5

6827 TURBULENT TRANSFER IN THE BOUNDARY LAYER OF A STRATIFIED FLUID. Shih-Kung Kao.

.Meteorol., Vol. 16, No. 5, 497-503 (Oct., 1959).

An analysis is made of some characteristics of the steady turulent transfer in the boundary layer of a stratified fluid. The effect f the heat flux on the variation of the mixing length and the flux ichardson number with height is determined. The velocity and temerature profiles are derived. It is found that for a constant freetream velocity an upward heat flux increases the friction velocity, hereas a downward heat flux decreases the friction velocity. The ower limiting value of the flux Richardson number is found to be 0.5 which, together with the upper limiting value, 0.5, obtained by ownsend (1958), gives the range of the flux Richardson number. elocity profiles for the non-neutral conditions converge in the igher level towards the profile for the neutral condition, a characeristic which agrees with the classical velocity profiles observed y Thornthwaite and Kaser (1943).

533.6

6828 THEORY OF VORTEX FORMATION NEAR A RESONATOR IN AN AIR STREAM. P.N.Kubanskii.

kust. Zh., Vol. 5, No. 3, 324-31 (1959). In Russian.

Motion of air in a resonator cavity and outside it was studied y placing a light powder (e.g. lycopodium) inside the resonator. ollmien's theorem was applied to the turbulent stream above the esonator aperture and characteristics of the flow were calculated. n the theoretical section of the paper the author gives a solution of he equation of time-averaged motion of gas in the resonator cavity and finds expressions for the stream function and the flow velocity components. A relationship between the velocity of flow in the esonator and the velocity of the main stream is established. The low lines for time-averaged motion in the resonator cavity are constructed and the mechanism of vortex formation is discussed. [English translation in: Soviet Physics—Acoustics (New York) Vol. 5, No. 3, 331-8 (Feb., 1960)].

A.Tybulewicz

533.6

6829 N WAVE PROPAGATING INTO A STRATIFIED ATMOSPHERE. S.G.Reed, Jr.

hys. of Fluids, Vol. 3, No. 1, 134 (Jan.-Feb., 1960).

Expressions for the variation with distance of the wavelength and the ratio over-pressure/ambient pressure are obtained for an N-wave (wave of finite amplitude). In an atmosphere with pressure decreasing exponentially with distance it is possible for the overpressure ratio to vary roughly as the fourth root of the ambient pressure (instead of the square root, as for acoustic waves).

J.G.Oldroyd

533.6 : 551.5

6830 FINITE-AMPLITUDE THREE-DIMENSIONAL HARMONIC WAVES ON THE SPHERICAL EARTH. H.L.Kuo.

. Meteorol., Vol. 16, No. 5, 524-34 (Oct., 1959).

By making use of the quasi-nondivergent approximation, the poential vorticity equation is reduced to an equation in the stream unction ψ. Assuming that the motion is of permanent wave type, a irst integral of this nonlinear vorticity equation is obtained, which tself is a linear three-dimensional partial differential equation in . This equation has been solved as a boundary-value problem by he method of separation of variables. It is found that the latitudinalmplitude functions of these waves satisfy a spheroidal-wave equaion while the vertical-amplitude functions are given by Bessel and ankel functions of the argument $l\sqrt{p/p_0}$, where l is a parameter epending on both the static stability and the nodal number r. The igenvalues μ_{mr} of these wave solutions are connected with the parameter l^2 by a transcendental relation. One has expanded μ_{mr} into a power series of l^2 and obtained the various coefficients, up to that of the fourth power of l^2. The latitudinal- and vertical-amplitude functions for the wave numbers m = 0,3, and 6 have also been obtained. Because of the additional degrees of freedom introduced by the vertical variation of ψ, it is possible to obtain a combination of the partial-wave solutions which can approximate the observed motions in the atmosphere more closely than the solutions of the purely two-dimensional vorticity equation can. When the effect of friction is included, these harmonic waves will be damped in time.

GASEOUS STATE

533.7

6831 A LATTICE MODEL OF A CLASSICAL HARD SPHERE GAS. D.M.Burley.

Proc. Phys. Soc., Vol. 75, Pt 2, 262-74 (Feb., 1960).

From an examination of the proposed lattice model of a hard-sphere gas, several interesting features are observed. It is found that for loose-packed lattices it is necessary to consider two regions, one ordered and one disordered, so that the whole pressure—density curve may be described. The disordered region, for these lattices, produces virial coefficients which oscillate in sign every three or four terms, and above a certain density the phase becomes unstable. Treatment of the ordered region is not altogether satisfactory but it appears that the phase disappears below a certain density. Consequently, there is a strong indication that a transition occurs for loose-packed lattices, but the nature and position of the transition is still in doubt. For the close-packed lattices, however, it is found that the gas has virial coefficients which are all positive and so seems to be able to condense into an ordered phase without any transition.

533.7 : 539.19

6832 RELAXATION OF PERIODIC MOTION IN AN ISOLATED SYSTEM OF HARMONIC OSCILLATORS. A.I.Osipov.

Dokl. Akad. Nauk SSSR, Vol. 130, No. 3, 523-5 (Jan. 21, 1960). In Russian.

Such processes can occur, under certain conditions, in diatomic gases, heated by a shock wave. In an isothermal vessel, the energy of transitional motion of molecules is transferred into vibration energy of oscillators. The author considers the kinetic equation of equilibrium of such a transfer and discusses its solution under simplified conditions.

J.K.Skwirzynski

533.7

6833 ROTATIONAL RELAXATION OF ROUGH SPHERES. B.Widom.

J. chem. Phys., Vol. 32, No. 3, 913-23 (March, 1960).

A theory of rotational relaxation of spherical top molecules in an inert gas is given, under the assumption that the molecules and atoms collide as rough spheres. Some general aspects of relaxation theory are first discussed and a theorem is presented which, under some circumstances, allows the problem to be greatly simplified. The rotational relaxation problem is then solved both for two- and three-dimensional systems. If I is the moment of inertia of the rotating molecule, m the reduced mass of the atom—molecule system, and a the sum of the atomic and molecule radii, and if $b = I/ms^2$, then the most important result of the three-dimensional theory is that $Z_{eff} = \frac{3}{8}(1 + b)^2/b$, where Z_{eff} is the number of collisions suffered by each molecule in a time equal to the relaxation time. This is the analog of a result previously derived by Wang Chang and Uhlenbeck for self-relaxation in the pure molecular gas. Values of Z_{eff} are calculated for a variety of mixtures of spherical top molecules with inert gases.

533.7

6834 THEORY OF GASES. XXIII. CALCULATION OF THE CONDENSATION COEFFICIENTS. LAWS OF ISO-CONDENSATION. J.Duclaux.

J. Phys. Radium, Vol. 18, No. 8-9, 505-11 (Aug.-Sept., 1957). In French.

For previous work see Abstr. 5938 (1955). The theory of the progressive condensation of real gases previously given has been modified and agrees with the law of mass action. Its basic assumption is that the individual molecules associate to form aggregates of

2, 3, 4 ... single molecules, no action taking place between the aggregates. The coefficients K of the mass action law have been calculated for nitrogen between -146° and 400° and show complete agreement with experiment. The isotherms obey two laws of isocondensation, by means of which any isotherm may be deduced from any other (basic isotherm), knowing two numbers: the factor F and the translation Δ. The two laws may be somewhat at fault close to the critical point, but elsewhere they are subject to errors less than 0.05%. The comparison with the equations of state of Van der Waals and Beattie and Bridgeman shows that agreement with the experimental numbers is greatly improved. The theory extends to other gases (oxygen, argon, neon) and leads to a new conception of the corresponding states, in which the critical data play no part. The method for the calculation of the coefficients K is outlined.

533.7 : 539.2

6835 COLLISION OF A GAS ATOM WITH A COLD SURFACE. R.W.Zwanzig.

J. chem. Phys., Vol. 32, No. 4, 1173-7 (April, 1960).

The collision transfer of kinetic energy from a gas atoms to a cold solid is investigated in a simple model. (The solid is one-dimensional; classical mechanics is used throughout; and simplified interactions are assumed). In two limiting cases the combined equations of motion of the atom and the lattice are solved exactly. The efficiency of energy transfer obtained from these calculations is much higher than that which is predicted from Lennard-Jones' single phonon approximation.

533.7

6836 THERMODYNAMIC PROPERTIES OF C_2. R.L.Altman.

J. chem. Phys., Vol. 32, No. 2, 615-16 (Feb., 1960).

Enthalpy and entropy values for diatomic carbon were calculated from spectroscopic data and are tabulated for temperatures between 100 and 5000°K. Confirmation of the results is obtained from calculation of the heat of sublimation of C_2. G.I.W.Llewelyn

533.7

6837 THE ISOTHERMS OF THE HYDROGEN ISOTOPES AND THEIR MIXTURES WITH HELIUM AT THE BOILING POINT OF HYDROGEN.

J.J.M.Beenakker, F.H.Varekamp and A.van Itterbeek.

Physica, Vol. 25, No. 1, 9-24 (Jan., 1959).

The second virial coefficients of H_2, HD and D_2 and their mixtures with helium were determined at the boiling point of hydrogen. The accuracy of the method is of the order of 10^{-4} amagat. Control measurements were performed on He, giving good agreement with Keesom's adopted values. The results for H_2 deviate about 7% from the data of Van Agt and Kamerlingh Onnes.

533.7

6838 COMPRESSIBILITY ISOTHERMS OF HYDROGEN AND DEUTERIUM AT TEMPERATURES BETWEEN -175°C AND +150°C (AT DENSITIES UP TO 960 AMAGAT).

A.Michels, W.de Graaff, T. Wassenaar, J.M.H.Levelt and P.Louwerse.

Physica, Vol. 25, No. 1, 25-42 (Jan., 1959).

Compressibility isotherms of hydrogen and deuterium are given in the following ranges of temperatures, densities, and pressures : hydrogen at temperatures from -175°C to -25°C and at densities up to 640 amagat (maximum pressure about 1000 atmospheres); at temperatures from 0°C to 150°C and at densities up to 960 amagat (maximum pressure about 2950 atmospheres); deuterium at temperatures from -175°C to -25°C and at densities up to 610 amagat (maximum pressure about 900 atmospheres); at temperatures from 0°C to 150°C and at densities up to 950 amagat (maximum pressure about 2800 atmospheres).

533.7

6839 THE PRESSURE DEPENDENCE OF REFRACTIVITY OF POLAR GASES.

A.R.Blythe, J.D.Lambert, P.J.Petter and H.Spoel.

Proc. Roy. Soc. A, Vol. 255, 427-33 (April 16, 1960).

The refractive indices of several gases have been measured at varying pressures in the range 0 to 50 cm. For carbon tetrafluoride, methyl fluoride and methyl chloride the refractivity varies directly with the density within the limits of experimental error. For ammonia and sulphur dioxide the increase of refractivity with pressure is less than would correspond to the increase in density. This may be interpreted in terms of a negative "first-order hyper polarizability" for the polar vapours, whose molecular polarizabil is being decreased by the influence of the field due to neighbouring molecular dipoles.

533.7 : 537.2 : 532

ON THE MOLECULAR THEORY OF THE KERR EFFECT.

See Abstr. 6798

533.7 : 537

6840 THE INFLUENCE OF ADDITION OF RADIOACTIVE SUBSTANCES TO AEROSOLS ON THE EMISSION EFFECT IN THE MEASUREMENT OF THE ELECTRIC CONDUCTIVITY OF AIR. G.Vogler.

Z. Naturforsch., Vol. 15, No. 1, 89 (Jan., 1960). In German.

Discusses the magnitude of the emission effect as a function the radioactive content of the sample gases measured.

S.J.St-Lora

VACUUM PHYSICS

53

6841 AN EXPERIMENTAL EQUIPMENT FOR OBTAINING VERY LOW PRESSURES. L.Pátý.

Slaboproudy Obzor, Vol. 21, No. 2, 106-9 (1960). In Czech.

The equipment is capable of producing vacua down to 10^{-11} m Hg. It consists of an ultra-high vacuum unit and an auxiliary high vacuum system comprising a diffusion pump producing a vacuum down to 10^{-6} mm Hg. The ultra-high vacuum unit is housed in an oven and consists of: (1) a pumping element with a titanium wire and two tungsten-wire heaters, (2) a Bayard–Alpert hot-cathode ionization vacuum gauge, and (3) an indium stop-valve which sepa ates the unit from the auxiliary system. The final evacuation is based on the "pumping" effect of the titanium when it is evaporate by the tungsten-wire heaters. A general description of the equipment given and its operation is discussed in detail.

R.S.Sidorowi

53

6842 INFLUENCE OF THE WALL TEMPERATURE ON TH SENSITIVITY OF THE THERMAL MANOMETER.

M.Varicak.

J. Phys. Radium, Vol. 18, Suppl. No. 7, 70A-72A (July, 1957). In French.

The possibility of increasing the sensitivity of thermistor vacuum gauges by lowering the wall temperature is theoretically a experimentally studied. The results show that temperature loweri though increasing the sensitivity of the gauge, makes it too inert to be useful in practice.

53

6843 THE APPLICABILITY OF A CAPACITY MICRO-MANOMETER AS AN ABSOLUTE PRESSURE MEASU INSTRUMENT. H.W.Drawin.

Z. InstrumKde, Vol. 68, No. 1, 1-8 (Jan., 1960). In German.

The author shows that a capacity-type micro-manometer can used to obtain an absolute measure of pressure in the range 1 to 10^{-5} mm Hg provided that one side of the manometer is maintaine at a pressure of 10^{-6} mm or lower. The gauge readings do not de on the nature of the gas, but parameters which can affect the accu are discussed. Good agreement was obtained with a McLeod gaug in pressure measurements with helium and argon. T.Mulv

53

6844 FORCED PERIODIC CHANGES OF KINETIC ENERGY OF GAS MOLECULES AS A MEANS OF VACUUM MEASUREMENT. H.Schwarz.

Rev. sci. Instrum., Vol. 31, No. 4, 433-8 (April, 1960).

Gas molecules in a container, under pressure lower than that attained when the mean free path is equal to or greater than the geometrical dimensions of the container, may impinge on a solid surface, the temperature of which can be made to change periodically. The frequency of this change is made equal to the mechani resonant frequency of a membrane held at constant low temperature. Depending on the time phase at which the gas molecules rea the hot surface, their kinetic energy varies with the same frequen his membrane will then vibrate up to large amplitudes when hit by e gas molecules coming from the periodically heated surface. The nplitude is a measure of the gas pressure. If a phase-sensitive ck-in amplifier system is employed, much greater sensitivity can achieved than is possible with the generally used Knudsen-type cuum gauges. A general solution for the temperature function and e radiometric force is given, and numerical curves for one ample are calculated.

VIBRATIONS · ACOUSTICS

534.1 : 621.3.018.6

6845 VIBRATION STUDIES IN THE SOVIET UNION. A REVIEW. Yu.I.Iorish.

kust. Zh. Vol. 5, No. 3, 263-74 (1959). In Russian.

The review deals only with the Soviet work (146 references) on armful mechanical vibrations; it does not deal with studies of the rigin or prevention at source of these vibrations. The review is ivided into four chapters: (1) measurement, (2) testing, (3) insulaion, (4) effect on instruments. [English translation in: Soviet Physics - Acoustics (New York), Vol. 5, No. 3, 269-81 (Feb., 1960)].

A.Tybulewicz

534.1

6846 THE OVERALL STABILITY OF FORCED FRICTIONAL OSCILLATIONS. R.Reissig.

bhandl. Dtsch. Akad. Wiss. Berlin Kl. Math. Phys. Tech., 1959. o. 1, 5-28. In German.

A theoretical treatment of a system having nonlinear damping, nonlinear spring constant and Coulomb friction. The main purpose s to examine the stability of the system under the action of continuusly applied disturbances.

H.J.H.Starks

534.1 : 517.9

NONLINEAR VIBRATIONS: A CONDITION FOR THE XISTENCE OF ORBITALLY STABLE SOLUTIONS OF DYNAMIAL SYSTEMS. See Abstr. 6537

534.11

6847 SUBHARMONIC OSCILLATION IN MELDE'S EXPERIMENT. W.Pong.

Amer. J. Phys., Vol. 28, No. 4, 366-7 (April, 1960).

The characteristics of the subharmonic oscillation found in Melde's experiment are described by an approximate solution of a nonlinear differential equation of the second order with a periodic coefficient. The steady variation of the string's tension may be ooked upon as an equivalent nonlinear effect.

534.11

6848 AMPLITUDE CORRECTIONS FOR VIBROSCOPE MEASUREMENTS. I.M.Stuart.

Brit. J. appl. Phys., Vol. 10, No. 5, 219-25 (May, 1959).

The dependence on amplitude of the fundamental resonant frequency for the free vibration of a string is derived for the two systems of mounting used in vibroscope measurements. It is found that in both systems a correction term of order $\frac{1}{e}\left(\frac{A}{l}\right)^2$ applies, where A is the amplitude, l the gauge length, and e a number called the incremental strain. As this strain e is usually small (of the order 1% from most textile testing), the correction term can be important at apparently low amplitudes.

534.12

6849 RESONANT FREQUENCY OF A WATER-LOADED CIRCULAR PLATE. F.C.W.Olson.

J. Acoust. Soc. Amer., Vol. 32, No. 3, 408 (March, 1960).

The theoretical fundamental frequency obtained by Peake and Thurston (Abstr. 5382 of 1954) is improved by assuming a better form for the deflection of the plate. The influence of stretching in the middle surface, of variation in edge clamping, and of amplitude on the frequency are shown in a table.

R.F.S.Hearmon

534.12

6850 TRANSVERSE VIBRATION OF HIGHER FREQUENCIES OF BEAMS OF UNIFORM CROSS-SECTION TAKING INTO ACCOUNT THE EFFECT OF SHEAR.

K.Terazawa and Y.Matsuura.

Technol. Rep. Osaka Univ., Vol. 8, 281-97 (Oct., 1958).

In order to obtain the correct natural frequency the problem was treated in the case of the beam with both ends supported and of the beam with free ends. The result obtained is that the effect of shear on the natural frequencies is of great importance particularly in the range of higher modes and the natural frequency obtained in this manner is considerably smaller in the range of higher modes than that obtained by the usual method of calculation in which only the bending moment of the beam is taken into account. The effect of rotary inertia was also investigated approximately and it is shown that the effect is generally smaller than that of shear and may be neglected in the lower modes of vibration.

534.13

6851 INPUT IMPEDANCES OF SIMPLE CYLINDRICAL STRUCTURES. P.A.Franken.

J. Acoust. Soc. Amer., Vol. 32, No. 4, 473-7 (April, 1960).

A thin cylindrical shell driven in vacuum below its radial resonance by a point force may be described by membrane theory. Each nonaxisymmetric modal impedance contains a resistance and a mass of equal magnitude, as in the case of an infinite bar. The impedance decreases with increasing mode number up to a "cutoff" mode, and stiffness effects become important for modes above the cutoff mode. The analysis includes finite shells and rings.

534.15

6852 THE MEASUREMENT OF THE STRAIN-DEPENDENT DAMPING OF METALS VIBRATING TORSIONALLY.

G.Sumner and K.M.Entwistle.

Brit. J. appl. Phys., Vol. 9, No. 11, 434-8 (Nov., 1958).

Apparatus is described for the measurement at room temperature of the mechanical damping of torsionally vibrating metal specimens up to shear strains of about 2×10^{-3} for mild steel. Vibrations are maintained by a moving-coil exciter which is energized by an electronic feedback circuit and controlled by a Rochelle salt detector coupled to the end of the specimen. The phase of the exciter current is adjusted to coincide with that of the angular velocity of the specimen so that absolute values of energy loss can be obtained by measuring the exciter current, the exciter force constant and the frequency and amplitude of vibration. Values so obtained for an aluminium alloy agree with the decrement measured by a free-decay test to about 1%. Evidence is reported which shows that such agreement would not be expected with ferromagnetic specimens because the free decay tests do not allow emough time for a cyclic condition to be attained at intermediate strains. The total extraneous energy loss in the apparatus is shown to be less than 3×10^{-5} of the vibrational energy of the system.

534.15

6853 TORSIONAL VIBRATIONAL EXPERIMENTS ON RECTANGULAR CONCRETE BEAMS. R.Jones.

Brit. J. appl. Phys., Vol. 10, No. 1, 51-2 (Jan., 1959).

Earlier anomalous results [Magazine of Concrete Research, Vol. 9, 69-72 (1957)] obtained in measuring the dynamic shear modulus of specimens of concrete by a torsional resonance technique are now explained satisfactorily. A theory, given by Davies in 1938 (Abstr. 1425 of 1938) predicts discrepancies in the apparent shear modulus obtained at higher harmonic resonances due to warping of the rectangular section during vibration. The experimental results are in extremely good agreement with Davies's theory, and it is found that the corrected shear modulus is not significantly influenced by the frequency at which it is measured. This conclusion agrees with the results obtained from torsional resonances on a concrete beam of circular cross-section for which no correction is required.

534.2

6854 SYSTEMATICS OF THE NATURAL ELASTIC VIBRATIONS OF [INFINITE] ISOTROPIC CIRCULAR CYLINDERS. E.Sittig.

Acustica, Vol. 7, No. 3, 175-80 (1957). In German.

The fundamental equations yield, beside the simple modes of vibration (longitudinal, torsional, flexural), more complicated modes. Altogether there is a threefold band of resonances with each resonance characterized by a triplet of integral indices (n,p,q,) which are related to the nodes on the cylindrical surface and can be experimentally determined. As the boundary problem of the cylinder of finite length cannot be rigorously solved, some departure from experiment is to be anticipated. For the special case of resonances with vanishing axial components, the discrepancies can be limited by comparison with the corresponding resonances of a thin circular disk.

534.2

6855 PROPAGATION OF THE THREE INDEPENDENT ELASTIC WAVES IN THE [1,1,0] DIRECTION IN LiF AND KI SINGLE CRYSTALS.

C.V.Briscoe and M.H.Norwood.
Physica, Vol. 25, No. 2, 111-15 (Feb., 1959).

The experiments indicate that the three elastic waves (one longitudinal and two transverse) move through a crystal independently and each with its characteristic velocity. This is in accord with theory and is so even when the three waves are excited simultaneously by a transducer. Pulse-echo techniques are used on single crystals of LiF and KI and quantitative data are taken on the relative amplitudes of the two transverse waves propagated along the [1,1,0] direction.

534.21

6856 WAVEGUIDE PROPAGATION OF SOUND IN LAYERED INHOMOGENEOUS MEDIA.

E.P.Masterov.
Akust. Zh., Vol. 5, No. 3, 332-6 (1959). In Russian.

The waveguide propagation of sound in a medium of refractive index (n) is discussed; n^2 obeys a bi-exponential law

$$n^2(z) = p^2 + (1 - p^2 + q)e^{-az} - qe^{-2az},$$

where p, q and a are parameters which determine the distribution of the refractive index. [English translation in: Soviet Physics—Acoustics (New York), Vol. 5, No. 3, 339-43 (Feb., 1960)].

A.Tybulewicz

534.21

6857 SOUND PROPAGATION IN DUCTS WITH SIDE BRANCHES.

W.K.R.Lippert.
Acustica, Vol. 7, No. 3, 137-45 (1957).

The propagation of plane waves in a main conducting duct having a closed side branch is represented by formulae and diagrams with the characteristic reflection and transmission factors. The practical limits of this representation are discussed in measured examples. An effective length of the side branch, which differs from the geometrical length, is derived from the measurements, and its usage is shown to extend the range of validity of the formulae and diagrams.

534.21 : 538.3

SOUND PULSES IN A CONDUCTING MEDIUM. See Abstr. 5392

534.22

6858 RAPID MEASUREMENT OF ULTRASONIC VELOCITY IN A LIQUID.

N.B.Terry.
Acustica, Vol. 6, No. 6, 521-5 (1956).

A mask with a known length of aperture (measured in the direction of the ultrasonic beam) is placed in the path of a beam of parallel white light which traverses the liquid. A Debye—Sears diffraction pattern is produced by high frequency ultrasonic waves which have been amplitude-modulated at a lower frequency. If the central image of the diffraction pattern is blocked, and light collected by a lens from the higher order spectra, an alternating light intensity at the modulating frequency is obtained which may be measured by a photocell-amplifier combination. It is shown theoretically that the modulating frequency corresponding to a minimum output of the photocell is related simply to the ultrasonic velocity, attenuation and length of mask aperture, and the expression obtained is confirmed experimentally by measurements on heptane. A measurement of ultrasonic velocity can rapidly be made, therefore, by simply tuning the modulating frequency to a minimum output from the photocell.

534.22

6859 MEASUREMENT OF THE SOUND VELOCITY IN THIN FILMS OF PLASTIC MATERIALS. UTILISATION IN THE INTERFEROMETRIC DETERMINATION OF THE VELOCITY OF SOUND IN LIQUIDS.

G.Laville and J.Maillet.
C.R. Acad. Sci. (Paris), Vol. 250, No. 7, 1206-7 (Feb. 15, 1960). In French.

The velocity in thin plastic films was determined from measurements of the radiation pressure with and without the interposition of the film between the source and detector. The velocity in liquids can be determined using two identical films between the source and receiver, one film being moved relative to the other.

H.D.Parbrook

534.22

6860 ORIGIN OF SHOCK WAVES IN CAVITATION.

W.Güth.
Acustica, Vol. 6, No. 6, 526-31 (1956). In German.

The shock waves radiated from cavitation bubbles in a nearly incompressible medium are described in terms of Rayleigh's theor The influence of the air content on the shock waves is briefly discussed and an explanation given for the unexpectedly high air content which is often found in cavitation bubbles.

534.2

6861 THE PROPAGATION OF SHOCK WAVES OF CONSTAN STRENGTH.

A.G.Mackie and D.G.Weir.
Proc. Cambridge Phil. Soc., Vol. 56, Pt 1, 64-74 (Jan., 1960).

Conditions are examined under which plane shock waves of constant strength can propagate through a gas in a given homentrop motion. Since the entropy change across the shock is taken to be constant, homentropic flow exists behind the shock also. The motic behind the shock is determined by solving a Cauchy problem with data given on the back of the shock. The theory is illustrated by two examples, one of which generalizes a result obtained by Copsor (Abstr. 3226 of 1954).

534.

6862 VIBRATION PHENOMENA IN DETONATION WAVES IN HYDROGEN—OXYGEN MIXTURES.

D.H.Edwards and T.G.Jones.
Brit. J. appl. Phys., Vol. 11, No. 5, 190-4 (May, 1960).

A photographic investigation is described, using a Schlieren system and rotating-drum camera, of detonation waves in hydroger oxygen mixtures propagating in a 1.5 cm diameter tube of circular section. It is found that mixtures near the limits of detonability exhibit the phenomenon of spin in which the motion is of long wavelength and the frequency is in agreement with values predicted by existing theories. In stronger detonating mixtures a high-frequenc spin of short wavelength is present which shows the same characte istics on a streak photograph as a normal long wavelength spin; measured values of frequency and wavelength agree reasonably wel with those calculated. In a range of mixtures of intermediate comp sition both types of vibration are present. Longitudinal pressure waves, the recurrence frequency of which is twice that of the funda mental mode transverse vibration, are also observed behind the detonation front in all mixtures; the existence of these waves is cor firmed by pressure recordings and a possible explanation of their origin is discussed.

534.

6863 POINT DETONATION IN AN INHOMOGENEOUS ATMOSPHERE.

A.S.Kompaneets.
Dokl. Akad. Nauk SSSR, Vol. 130, No. 5, 1001-3 (Feb. 11, 1960). In Russian.

The propagation of a shock wave which originates in a detonati at a geometrical point is studied by means of an approximation method.

R.Eisenschi

534.

6864 MELTING OF A HEAT-CONDUCTING WALL BEHIND A MOVING DENSITY DISCONTINUITY.

G.A.Tirskii.
Dokl. Akad. Nauk SSSR, Vol. 129, No. 5, 989-92 (Dec. 11, 1959). In Russian.

Gas in a shock wave heats and melts a solid wall along which the wave is propagated. The surface is accordingly covered with a flowing layer of liquid. The mathematical theory of the process, i particular the distribution of temperatures and velocities near the boundary, are presented in some detail but no clear-cut result is given.

R.Eisenschit

534.22 : 537

ELECTRICAL CONDUCTIVITY NEAR EXPLOSION WAVE-FRONTS. See Abstr. 7061

534.22 : 53

THE LINEAR RELATION BETWEEN THE MATERIAL VELOCITY AND THE SHOCK-WAVE VELOCITY IN A METAL. See Abstr. 6010

534.23 : 532

6865 NONLINEAR OSCILLATIONS OF AIR BUBBLES IN WATER.

W.Güth.
Acustica, Vol. 6, No. 6, 532-8 (1956). In German.

The vibration characteristics of bubbles excited to large ampl tudes are investigated. Both in free and forced vibration, the chan of frequency, mean bubble radius and the mean internal air pressu are calculated in their dependence on amplitude. Approximate lutions for the nonlinear vibration are calculated in both cases. e resonance curves under forced vibration are calculated. A usible explanation of the incidence of subharmonics is given.

534.23

6866 OSCILLATIONS AND SOUND EMISSION OF A JET OF COMPRESSED AIR STUDIED WITH AN ULTRA-RAPID LECTRONIC CAMERA. F.Canac and M.Merle.
R. Acad. Sci. (Paris), Vol. 250, No. 10, 1795-7 (March 7, 1960). French.

Jets issuing from nozzles of various shapes and dimensions ve been shown to oscillate with a definite frequency which de- eases with increasing gas pressure. The pattern of sound waves corded by a schlieren system has the same frequency as the otion of the jet. E.R.Wooding

534.23

6867 ANALYSIS OF DISTORTION IN THE FIELD OF A PLANE PIEZOELECTRIC RADIATOR. I.N.Kanevskii.
okl. Akad. Nauk. SSSR, Vol. 129, No. 4, 766-8 (Dec. 1, 1959). Russian.

A barium titanate transducer was vibrated at frequencies between 4 and 0.8 Mc/s in air and in water. The nodal lines, the phase hifts between opposite points on the transducer, and the distri- ution of amplitude were investigated. The results indicate that anding longitudinal waves in the transducer may lead to inhomo- eneities in the ultrasonic field. R.F.S.Hearmon

534.23 : 538.56

6868 SOME ASPECTS OF THE DESIGN OF STRIP ARRAYS. D.G.Tucker.
custica, Vol. 6, No. 5, 403-11 (1956).

Gives a simple treatment of the design and performance of strip rrays from the point of view of their far-field directional patterns, cluding as an important example the determination of the bearing a received signal. The main principle involved is that of synthe- zing any arbitrary pattern by the linear superposition of curves of e x^{-1} sin x type, having suitable peak amplitudes spaced at intervals π in the x-scale. The treatment of the design of arrays by this ocess gives a clear picture of the relationship between the direc- onal pattern and the distribution of excitation or sensitivity ccording to whether transmission or reception is concerned) over e length of the array.

534.23

6869 VISCO-INERTIAL DISPERSION AND ATTENUATION OF SOUND IN HIGHLY CONCENTRATED SUSPENSIONS. S.Nesterov.
kust. Zh., Vol. 5, No. 3, 337-44 (1959). In Russian.

Propagation of sound in a highly concentrated suspension is ealt with assuming that the suspension consists of small cylinders ach surrounded by a comparatively thin sheath of liquid. Formulae re obtained for the density of the suspension and for the velocity and ttenuation of sound in it, as a function of frequency, geometrical and echanical parameters of the suspension. Applications of the theory re outlined. [English translation in: Soviet Physics—Acoustics New York), Vol. 5, No. 3, 344-51 (Feb., 1960)]. A.Tybulewicz

534.23

6870 THE CHOICE OF RESILIENT MATERIALS FOR ANTI-VIBRATION MOUNTINGS. J.C.Snowdon.
rit. J. appl. Phys., Vol. 9, No. 12, 461-9 (Dec., 1958).

The criteria are defined for a good anti-vibration mount aterial, solely from the aspect of vibration reduction. Such a aterial should possess a high damping factor which does not in- rease greatly with frequency, and be free from any major increase n dynamic modulus with frequency. Results of transmissibility easurements on a variety of resilient materials indicate that high amping synthetic rubbers normally possess a dynamic modulus hich increases rapidly with frequency. It is shown that this modulus ncrease is responsible for the poor isolation afforded by these ubbers at frequencies above the resonant frequency of the mounting ystem, and not their inherent high damping as commonly supposed. Filled butyl rubber is an exception, affording an isolation at high requencies not greatly inferior to that of natural rubber, yet at the ame time possessing much higher damping.

534.23 : 539.2

ABSORPTION OF ULTRASONIC WAVES BY METALS IN A TRONG MAGNETIC FIELD. See Abstr. 6012

534.23 : 539.2

PHONON VISCOSITY AND ITS EFFECT ON ACOUSTIC WAVE ATTENUATION AND DISLOCATION MOTION. See Abstr. 6043

534.24

6871 WAVE IMPEDANCE AND SPECIFIC IMPEDANCE IN ACOUSTICS. G Laville and T.Vogel.
Acustica, Vol. 7, No. 2, 101-9 (1957). In French.

If impedance is defined as an operator that permits one to go from an "effect" back to a "cause" (in hydrodynamics, from velocity to pressure), it is seen that the impedance field of a wave is constant only in the case of a plane wave This absolute character of the impedance of a plane wave makes it possible to construct a standard, of which a cylindrical example is described and discussed. The situation changes completely once a second dimension is introduced (a plane wave striking an oblique obstacle or a more complicated case); the specific character of the impedance of an obstacle is generally assumed but must be checked by experiment. A discussion of the possible conditions shows that one can choose between two assumptions, one of specific normal impedance which compares the obstacle to a perfect fluid, and the other, of an oblique impedance, which generalizes the preceding case and makes it possible to consider the equivalent fluid as viscous or even to treat the obstacle as an isotropic solid. It is shown how to verify experimentally which of the two hypotheses is applicable, and results of such a verification are presented.

534.24

6872 REFLECTION AND REFRACTION OF SOUND BY SHOCK WAVES. V.M.Kontorovich.
Akust. Zh., Vol. 5, No. 3, 314-23 (1959). In Russian.

Discusses plane steady-state shock waves propagated in an infinite non-viscous liquid or gas and their interaction with a monochromatic acoustic wave or a similar small perturbation. It is assumed that the Rankine—Hugoniot conditions are satisfied at the surface of discontinuity. The acoustic reflection and transmission coefficients are found and the laws of reflection and refraction are given in a simple geometrical form. "Acoustic location" of the discontinuity surfaces is also discussed. [English translation in: Soviet Physics—Acoustics (New York), Vol. 5, No. 3, 320-30 (Feb., 1960)]. A.Tybulewicz

534.26

6873 A GENERALIZED HYDRODYNAMICAL THEORY OF AN ULTRASONIC INTERFEROMETERS. I.I.Ol'khovskii.
Dokl. Akad. Nauk SSSR, Vol. 130, No. 4, 747-50 (Feb. 1, 1960). In Russian.

The theory in its previous form is improved by taking account of the conduction of heat in the interior and at the boundary of the gas in which waves are propagated. Results are compared with the experimental frequency—wave-number curve for gaseous argon. R.Eisenschitz

534.26

6874 THEORY OF THE ACOUSTIC INTERFEROMETER FOR PLANE WAVES. F.E.Borgnis.
Acustica, Vol. 7, No. 3, 151-74 (1957).

A detailed investigation is presented of the electric input impedance of a piezoelectric bar and plate, loaded at one face with the acoustic impedance of an interferometer path, and free at the opposite face. The calculations start from the basic piezoelectric equations of state and lead rigorously to the strict expression for the total electric input impedance. The various properties of this impedance are discussed for variable path length of the interferometer, for variable acoustic wavelength and for a variation of the driving electric frequency. Under ordinary experimental conditions the input impedance can be represented by means of circle diagrams. The theoretical results are illustrated by numerical examples for water at 15 Mc/s and air at 1 Mc/s. The theory presented provides a rigorous foundation for the theory of the acoustic interferometer given by Hubbard (1931 and 1932) and extends it in various directions. The treatment includes the basic equations needed for the investigation of highly absorptive media.

534.26

6875 CALCULATION OF DIFFRACTION OF CONVERGENT CYLINDRICAL WAVE BY A SPHERE. I.N.Kanevskii.
Akust. Zh., Vol. 5, No. 3, 294-300 (1959). In Russian.

Discusses diffraction of an infinite convergent cylindrical wave by a sphere whose centre lies on the wave axis. An expression is obtained for the resultant field potential as well as asymptotic expressions for the scattered wave intensity and the effective scattering cross-section. These expressions are compared with the case of scattering of a plane wave by a sphere whose perimeter is small compared with the incident wavelength. [English translation in : Soviet Physics — Acoustics (New York), Vol. 5, No. 3, 300-7 (Feb., 1960)]. A.Tybulewicz

534.26 : 538.56

6876 THE DIFFRACTION OF A PLANE WAVE THROUGH TWO OR MORE [PARALLEL] SLITS IN A PLANE SCREEN. E.B.Hansen.

Appl. sci. Res. B, Vol. 8, No. 2, 73-83 (1960).

The diffraction of a plane acoustic wave through two or more parallel slits in a plane screen is investigated by means of integral equation technique. Numerical calculations of the transmission coefficient are carried out in some simple cases.

534.26

6877 SCATTERING OF SOUND ON A NON-UNIFORM SINUSOIDAL SURFACE WITH NORMAL ACOUSTIC ADMITTANCE. I.A.Urusovskii.

Akust. Zh., Vol. 5, No. 3, 355-62 (1959). In Russian.

Solves approximately the problem of scattering of sound by an inclined sinusoidal surface with normal acoustic admittance. The exact integral equation which describes the field on the surface was solved approximately; the field above the surface was found from the field on the surface using Green's formula. The region of applicability of the solution obtained in this way does not depend on the properties of the incident acoustic field of a given frequency; for example the solution obtained for an incident plane wave is valid for all angles of incidence. [English translation in: Soviet Physics—Acoustics (New York), Vol. 5, No. 3, 362-9 (Feb., 1960)]. A.Tybulewicz

534.26 : 551.5

6878 EXPERIMENTAL INVESTIGATION OF SOUND SCATTERING IN A TURBULENT ATMOSPHERE.

M.A.Kallistratova.

Dokl. Akad. Nauk SSSR, Vol. 125, No. 1, 69-72 (March, 1959). In Russian.

A preliminary account of experiments carried out in the autumn of 1958 at the Tsimlyansk station of the Institute for Atmospheric Physics of the Academy of Sciences, U.S.S.R. At the ends of a 40 m base-line, a transmitter and receiver microphone were set up. The polar diagrams showed a (half-strength signal-angle)/2 of 1.5°. A theory of the scattering is worked out which agrees with the experimental results for angles of 25-30°. The possibility is discussed of investigating the structure of atmospheric turbulences over a range of dimensions near to the internal dimensions of the turbulence. C.R.S.Manders

534.26

6879 BISTATIC SCATTERING FROM TOTALLY REFLECTING FLAT PLATES. P.W.Ankerman and R.A.Rubega.

J. Acoust. Soc. Amer., Vol. 32, No. 4, 478-81 (April, 1960).

This paper deals with an investigation of the characteristics of the scattering of sound from a flat plate, five wavelengths long. The scatter patterns were calculated based on the simplifying assumption of total reflection and experimentally checked by echo ranging in air. Agreement was found to be reasonably good although some interesting deviations in the side-lobe structure were observed. Patterns calculated and experimentally obtained include bistatic backscatter patterns as well as the scatter patterns for a given incident wave.

534.39

6880 THEORETICAL AND EXPERIMENTAL INVESTIGATION OF THE QUARTZ WIND [STREAMING].

I.Johnsen and S.Tjötta.

Acustica, Vol. 7, No. 1, 7-16 (1957). In German.

The sound-beam is assumed to be divergent, and a first-order solution for the density of the fluid used. This expression is introduced into the Navier—Stokes differential equation, by means of which a time independent second-order solution of the streaming in a tube can be found. In order to measure the absolute sound-intensity and the streaming velocity experimental methods have been developed. Theoretical and experimental results are compared, and they show good agreement. The results of this investigation are compared with the calculation made by Eckart (Abstr. 1180 of 1948). By means of streaming measurements and sound absorption data the ratio of the second and the first viscosity coefficient μ'/μ is found in the case of water, ethyl alcohol and (n)-propyl alcohol, and a complete agreement is obtained by the two methods.

534.39 : 536.

EFFECT OF SOUND WAVES ON HEAT TRANSFER.

See Abstr. 5198

534.4

6881 FOURIER SERIES FOR THE FINITE AMPLITUDE SOUND WAVEFORM IN A DISSIPATIONLESS MEDIUM.

L.E.Hargrove.

J. Acoust. Soc. Amer., Vol. 32, No. 4, 511-12 (April, 1960).

A general expression is derived for the Fourier coefficients describing the change in waveform of an initially sinusoidal plane progressive acoustic wave of finite amplitude in a dissipationless medium. The first four Fourier coefficients are graphically presented for distances up to the discountinuity distance.

534.

6882 A SIMPLE METHOD FOR THE HARMONIC ANALYSIS OF AN ULTRASONIC WAVE.

W.G.Mayer and E.A.Hiedemann.

Naturwissenschaften, Vol. 47, No. 3, 55 (1960).

A barium titanate probe and heterodyne voltmeter permit determination of the change of wave shape with distance of high intensity waves in fluids. A few results for the growth of the second harmoni are given. H.D.Parbrook

534.4

6883 INTERFEROMETRIC ANALYSIS OF EVEN HARMONIC DISTORTION OF ULTRASONIC WAVES. W.G.Mayer.

J. Acoust. Soc. Amer., Vol. 32, No. 4, 509-10 (April, 1960).

Placing two transducers in an ultrasonic wave one-half wavelength apart in the direction of sound propagation and comparing the electrical signals from the transducers is used to record even harmonic components of a distorted ultrasonic wave while the fundamental and odd harmonics are cancelled.

534.

6884 THE RENDERING VISIBLE OF STATIONARY ULTRASONIC FIELDS AND ACOUSTICO-OPTICAL IMAGE CONVERSION. G.Keck.

Acustica, Vol. 6, No. 6, 543-8 (1956). In German.

Existing methods of exploring ultrasonic fields are surveyed an the transposition of acoustic into optical images is briefly discussed New methods are described, with particular reference to the recording of the distortion of a liquid surface, or of the pressure changes within the liquid, on gelatine or silver films. The photographic plate, usually insensitive to ultrasonics, can be made quite sensitive by irradiating the developed silver films of a plate in a reversal bath. In this way it is possible, with exposure times of the order of seconds (even in weak sound fields) to obtain practical acoustic-optical images.

534.

6885 CONTRIBUTION TO THE STUDY OF THE ABSOLUTE ZERO [THRESHOLD] OF AUDIOMETERS.

P.Chavasse and R.Lehmann.

Acustica, Vol. 7, No. 2, 132-6 (1957). In French.

The problem of the specification for audiometers has arisen in a number of countries since 1936, and since then diverse standards differing mainly in the definition and value of the absolute threshold at various frequencies, have been adopted. These differences are discussed in relation to three series of experiments conducted in France since 1942, with a view to defining a standard of minimum audibility for use on airways. The methods and apparatus used and especially the technique of correlating results on artificial and hum ears are outlined. The results are compared with those of previou researches and proposals for submission to an international discussion based thereon are made.

534.

6886 CALIBRATION FOR CARRIER OPERATED MICROPHONES AND OTHER REVERSIBLE TRANSDUCERS.

M.D.Burkhard, E.L.R.Corliss, W.Koidan and F.Biagi.

J. Acoust. Soc. Amer., Vol. 32, No. 4, 501-4 (April, 1960).

An insert technique makes it possible to carry out sound press measurements using a microphone operated in a carrier circuit wi almost the same accuracy as can be achieved with more convention preamplifiers. The carrier system is modified to include a microphone polarizing voltage if the transducer is not self-polarized. Then a calibrating audio-frequency voltage is used to drive the transducer diaphragm to the same displacement amplitude as that generated by the sound pressure. Instead of matching the open-circuit voltage of the microphone, diaphragm motion is matched. A displacement response constant, independent of frequency, is used to determine sound pressure, in contrast to the usual open-circuit response, which depends on frequency. In a manner analogous to the determination of open-circuit pressure response by the reciprocity technique, the acoustic admittance of the microphone may be evaluated from a series of three voltage ratio measurements and the calculated acoustical transfer admittance of a calibrating coupler. This result can be combined with the open-circuit pressure response determined by the reciprocity technique to give an explicit evaluation of the electromechanical coupling constant.

534.6

6887 MICROPHONE DIAPHRAGM NULL METHOD FOR SOUND PRESSURE MEASUREMENT. W.Koidan.

J. Acoust. Soc. Amer., Vol. 32, No. 4, 505-7 (April, 1960).

A null technique is described for accurately measuring sound pressure with a condenser microphone while its diaphragm is held stationary. The method is particularly useful when it is desirable that the microphone present an infinite impedance to the medium and absorb no energy from the sound field. Sound pressure is determined by means of the electromechanical coupling constant, defined as $\phi = (p/e)_{u=0}$ where p is the sound pressure, e is the alternating voltage applied to the microphone terminals, and u is the volume velocity of the diaphragm. By using this definition, a concise derivation of an expression for ϕ in terms of measurable quantities is described. The value of ϕ for two Western Electric Company type 640 AA condenser microphones was measured as constant with frequency to within ±0.25 dB from 500 c/s to 20 kc/s. The effect of the finite acoustic impedance of a microphone on the magnitude of the incident sound pressure is calculated in terms of quantities obtained by driving the microphone electrically. The measurement of high sound pressure levels in resonant tubes is also discussed.

534.6

6888 THE FLUCTUATION THRESHOLD OF MICROPHONE SENSITIVITY. A.O.Sall'.

Akust. Zh., Vol. 5, No. 3, 351-4 (1959). In Russian. English translation in : Soviet Physics-Acoustics (New York), Vol. 5, No. 3, 358-61 (Feb., 1960).

An equation is obtained for calculating the sensitivity threshold due to thermodynamic fluctuations in the moving system, and to temperature variations in the volume behind the membrane.

534.6

6889 METHOD FOR MEASURING AND CALCULATING THE DIFFRACTION COEFFICIENT OF [CONDENSER] MICROPHONES. A.N.Rivin and V.A.Cherpak.

Akust. Zh., Vol. 5, No. 3, 345-50 (1959). In Russian. English translation in: Soviet Physics—Acoustics (New York), Vol. 5, No. 3, 352-7 (Feb., 1960).

The method of measurement is based on a direct determination of the ratio of the potentials generated at the output of the microphone while operating in conjunction with a pickup of the same type in a free field and in a closed chamber of small volume. A 2% accuracy is claimed. The analytic relations and graphs given demonstrate that the nonuniform pressure distribution on the membrane must be considered in the calculation of the diffraction coefficient, together with the relation between the diameters of the membrane and the housing of the microphone.

534.8

6890 VERY HIGH ENERGY ULTRASONICS. E.A.Neppiras.

Brit. J. appl. Phys., Vol. 11, No. 4, 143-50 (April, 1960).

The field of high power ultrasonics covers the power region where irreversible changes can be produced in the medium. The more important effects and uses of high energy ultrasonics are listed in tabular form. The field is very large; useful applications now touch almost every industry. Approximate figures are quoted for the order of the ultrasonic intensity required in the various applications. In gases and liquids the intensities obtainable are severely limited. In liquids this limit is fixed by cavitation which sets in at a rather low level. Cavitation can be avoided by pressurization, and then very high energies can be transmitted. But this is inconvenient and seldom used in practice. The field of very high energy ultrasonics is therefore practically confined to solids, as indicated in the table.

534.83

6891 RECENT STUDIES OF NOISE PROBLEMS. G.G.Parfitt.

Brit. J. appl. Phys., Vol. 11, No. 2, 53-7 (Feb., 1960).

Some fairly recent work on various aspects of acoustic noise was reviewed at a half-day symposium held in London in March 1959 by the Acoustic Group of The Physical Society. One group of papers discussed studies of the parameters of noise which were important in determining the subjective loudness, the possible damaging effects on human hearing, the influence on working efficiency and the annoyance caused in residential and working communities. Of the more purely technical papers, one considered some of the difficulties in making measurements of noise from aircraft to the relatively high degree of accuracy often required, while the other described results of measurements and analysis of the noise from automotive diesel engines.

534.83

6892 LOUDNESS OF COMMON NOISES. P.H.Parkin.

Acustica, Vol. 7, No. 1, 57-8 (1957).

The loudness levels in phons of some common noises were calculated from octave analyses by four methods. H.D.Parbrook

534.83

6893 THE STRUCTURE OF THE SOUND FIELD OF TURBOJETS. M.Kobrynski.

Acustica, Vol. 7, No. 2, 121-6 (1957). In French.

The sound field of several turbojets is studied in terms of jet aerodynamic parameters. The recordings obtained in many azimuths and at several distances make it possible to plot isobaric curves and to determine the location of the jet "rings" which are associated with the frequency bands of the acoustic spectrum. The spatial distribution of sound energy seems to be connected with the flow Mach number and to the size of the jet. When the gaseous velocity is small the azimuth of the lobes is about 70° from the jet axes for high frequencies, and 20° for low frequencies. For increasing velocities a rotation of the lobes towards a limit azimuth is observed, and also a variation of the exponent n of the velocity V in the expression $W_a/S = \rho^2 S^m V^n$, where W_a is the acoustic power, ρ the gas density, and S the cross-sectional area of the nozzle. In the expression n reaches a maximum value for mean frequencies. Its mean value for the whole spectrum is of the order of 6; the value of m is greatest at low frequencies and differs little from zero for the whole spectrum. The sound source factor η ("efficiency"), defined as $\eta = W_a/W_j$, where W_j is the mechanical power of the jet, seems to vary according to the 4.5 power of the Mach number for $M > 1$.

534.83

6894 PROPAGATION OF BAND LIMITED NOISE. M.W.Smith and R.F.Lambert.

J. Acoust. Soc. Amer., Vol. 32, No. 4, 512-14 (April, 1960).

Theoretical and experimental work on the propagation of band-limited noise in a phase wave tube are here reported. Characteristics of the spatial crosscorrelation curve are controlled by the arithmetic mean frequency of the band and the bandwidth of the noise. The amplitude of the correlation function for zero spatial separation is directly proportional to the total power Ak_b where A is the density of the cross power spectra and k_b is the bandwidth in wave number. Agreement between theory and experiment is quite good for relatively small spatial separations.

534.84

6895 RECENT STUDIES OF OPEN-AIR THEATRES. F.Canac.

Acustica, Vol. 7, No. 2, 69-74 (1957). In French.

Halls with vertical reflecting walls open to the sky show remarkable acoustic properties, which can be explained on the ray theory or by trials in models or in the theatres themselves. The technique of the construction of such halls can be summarised thus: keep the first reflections and eliminate the multiple ones.

534.84

6896 MULTIRESONANCE VOLUME ABSORBER. M.Abramchik and I.Maletskii.

Akust. Zh., Vol. 5, No. 3, 275-81 (1959). In Russian. English translation in : Soviet Physics-Acoustics (New York), Vol. 5, No. 3, 282-7 (Feb., 1960).

Discusses various types of multiresonance volume absorber, which make it possible to expand the frequency range of a desired absorption by separating the inside volume and by the application of flexible perforated walls. The properties of such an absorber in a field of normally-incident waves are considered theoretically using electromechanical analogues and general equations are obtained for the input impedance. A classification of the various types of absorber is given as a function of their construction. The effect of the distance of the absorber from the ceiling and the distance between absorbers when the latter are applied in a group were investigated experimentally. The existence of certain optimum distances was found. It is concluded that volume absorbers can serve as an effective means for noise control.

534.84

6897 A SUBJECTIVE METHOD FOR EVALUATION OF SOUND INSULATION. J.J.Geluk.

Acustica, Vol. 7, No. 2, 84-90 (1957).

A method is described by which it is possible to simulate, by means of simple electronic circuits, the behaviour of wall constructions in relation to airborne sound. Both single and double wall constructions are incorporated, being correct for the low frequency range only. A recording of the sound level on the site of the future construction enables the architect to judge the residual sound level in the finished building, taking into account the discrepancies that exist between simple theory and practical measurements. These discrepancies are, however, not accurately known for lightweight constructions, so the method is not suited to those cases.

534.84

6898 INVESTIGATIONS ON THE OPTIMUM REVERBERATION TIME. M.Kwiek and E.Karaśkiewicz.

Acta tech. Hungar., Vol. 22, No. 3-4, 233-53 (1958). In German.

On theoretical grounds it is shown that the following parameters, which determine the acoustics of a room, are independent of each other: (a) the reverberation time as a function of frequency, (b) the volume and the length of the room and (c) diffusity. These factors have been studied experimentally to determine the "optimum acoustics" of rooms and concert halls. The reverberation time was artificially varied with the aid of an acoustic delay line. The size of the room was also imitated artificially by gradual delaying of 24 loudspeakers on the walls of the room. By such devices, the equivalents of halls of 800, 1600, 3500, 4500, and 10 000 m^3 volume were obtained, with 5 types of frequency characteristics and 4 reverberation times.

A.B.Wood

534.84

6899 EMPIRICAL ACOUSTIC CRITERION (SECOND PAPER). T.Somerville and J.W.Head.

Acustica, Vol. 7, No. 2, 96-100 (1957).

For previous work, see Abstr. 2211 (1954). Further objective and subjective investigations have been carried out to test the validity of an empirical acoustic criterion. By this means, it has been possible to establish for large enclosures an improved version of the original criterion and a new criterion, taking account of volume. A nomogram for the new criterion is included. For small enclosures, such as talks studios, it has been impossible to obtain satisfactory criteria and further investigation is necessary.

534.88

6900 UNDERWATER CAMERA POSITIONING BY SONAR. H.E.Edgerton and J.Y.Cousteau.

Rev. sci. Instrum., Vol. 30, No. 12, 1125-6 (Dec., 1959).

Describes a 12 kc/s pulse circuit and recorders designed to monitor the camera—sea-bottom distance to within six feet at depths up to 2600 fathoms (3 miles)

J.Jarzynski

OPTICS . PHOTOMETRY

535.22 : 523.4

VELOCITY OF LIGHT AND MEASUREMENT OF INTERPLANETARY DISTANCES. See Abstr. 6574

535.24

6901 ABSOLUTE MEASUREMENT OF LIGHT INTENSITIES. M.E.Haine; J.S.Preston.

Brit. J. appl. Phys., Vol. 10, No. 9, 428, 428-9 (Sept., 1959).

The first author points out that, in many papers, light intensiti are only given relatively and not in absolute units. It is suggested that editors of scientific journals should persuade authors to use absolute units. The second paper agrees with the criticism and gives a number of reasons for the failure of authors to use absolut units.

R.W.Fi

535.24 : 7

6902 DENSITOMETER WEDGE FOR MEASUREMENTS AT LOW OPTICAL DENSITIES. N.R.Silvester.

J. sci. Instrum., Vol. 37, No. 1, 33-4 (Jan., 1960).

For the quantitative evaluation of electron micrographs a continuous wedge has been simply made in which, over the range 0 to 1.0, the optical density varies exponentially along its length within an accuracy of ±5%. Its construction and method of use are described. An application is indicated in measurements of the mass of electron-microscope specimens and similar uses in contact microradiography and microspectrophotometry are suggested.

535.2

6903 NEW METHODS FOR DETERMINATION OF THE COEFFICIENTS OF LIGHT EMISSION POWER (ALBE AND THE TRUE TEMPERATURE OF RADIATING SURFACES. D.Ya.Svet.

Dokl. Akad. Nauk SSSR, Vol. 129, No. 6, 1290-2 (Dec. 21, 1959). In Russian.

The modulation reflectometer method is particularly suitable for the measurement of surface emissivity of metals at high temperatures, especially during their passage from one phase to another. To avoid errors due to a finite size of light beam, menisc etc., the author suggests a new method where the light emission po is not determined by the absolute value of the reflection coefficient but by considering those parts of spectrum where the brightness temperature changes most.

J.K.Skwirzynsk

GEOMETRICAL AND INSTRUMENTAL OPTIC SPECTROSCOPY

(Optical spectra and their analysis are included under the appropriate heading, e.g. Atoms, Molecules, Solid-State Physics, etc.)

535

6904 THE TRANSMISSIVITY OF ARSENIC GLASS IN THE 15 μ TO 25 μ RANGE. H.Prokopová and A.Vaško.

Czech. J. Phys., Vol. 9, No. 2, 270 (1959).

The transmission curve for this range is given and shows a transmission band in the region of 17 μ.

E.A.Musse

535

6905 TURBID MEDIA WITH PLANE-PARALLEL SURFACE F.Kottler.

J. Opt. Soc. Amer., Vol. 50, No. 5, 483-90 (May, 1960).

In the case of uniformly diffuse internal incidence on a plane surface, formulae for the internal reflectance based on Fresnel's laws have been given by Walsh and Judd. Several investigators of turbid media such as opal glasses have found, however, experimen values smaller than these. A new explanation is given in the prese paper based on refraction instead of imperfect diffusion as suggest in the literature. It is verified by a series of observations with tw kinds of opal glasses. The only formulae used in this paper are th given long ago by Stokes, adapted for diffuse incidence. A unique solution of the Stokes formulae is given here. The underlying theo is the two-constant Schuster theory, whose shortcomings are also discussed.

535.

6906 A QUASI-SYMMETRICAL REFLECTING OBJECTIVE. M.Gaj.

Optik, Vol. 17, No. 1, 38-48 (Jan., 1960). In German.

A method of calculating a quasi-symmetrical objective with on reflecting surface is developed. A numerical example is given to illustrate the possibilities of the system. The system obtained represents a normal type of objective with a relative aperture f/2.5 an angular field $2\mu = 30^\circ$.

535.31

6907 A PARTICULAR CLASS OF CONCENTRIC OPTICAL SYSTEMS. G.Toraldi di Francia and M.T.Zoli.

Atti Fond. Ronchi, Vol. 15, No. 1, 90-7 (Jan.-Feb., 1960). In Italian.

A class of optical systems with spherical symmetry is considered which consists of an outer shell with constant refractive index n_1 and a core. The refractive index of the core is a given simple function n(r) of the distance r to the centre of the system. The spherical aberration was computed for several systems of this kind. It was found that a system, in which the refractive index varies slowly within a limited range in the core (with the exclusion of the centre), has a lower spherical aberration than a system in which the index is constant both in the shell and in the core.

535.31

6908 EQUIPMENT AND METHOD FOR PHOTOELECTRIC DETERMINATION OF IMAGE CONTRAST SUITABLE FOR USING SQUARE WAVE TARGETS. F.W.Roseberry.

J. Res. Nat. Bur. Stand., Vol. 64C, No. 1, 57-64 (Jan.-March, 1960).

Conventional measurements of the resolving power of lenses employ measuring photographs of test charts containing an array of accurately spaced paralled lines. This method has limited precision because of the variability of photographic emulsions and is time-consuming in operation. This paper extends previous work by others in obviating these difference by using a direct photoelectric scanning of a line-pattern image formed by the lens under test. Square wave high contrast resolving power targets with two different line pattern arrangements were used as test objects. The image was moved across a stationary slit and photomultiplier tube. The output was recorded as relative transmission.

535.31 : 538.56 : 621.396.677.81

GENERALIZATIONS OF SPHERICALLY SYMMETRIC LENSES.

See Abstr. 5401

535.31

6909 GEOMETRICAL-OPTICAL CALCULATION OF FREQUENCY RESPONSE FOR SYSTEMS WITH COMA.

A.S.Marathay.

Proc. Phys. Soc., Vol. 74, Pt 6, 721-30 (Dec., 1959).

The usefulness of the geometrical-optical treatment of frequency response is considered here for the case of coma, an aberration having odd symmetry. Calculations of frequency response and phase shift using this treatment have been made, for different orientations of incoherent line objects, in the presence of Seidel coma in different focal planes. Similar calculations have been made for higher-order coma in the Gaussian focal plane. Results are also given according to a mixed treatment of frequency response. The results are compared with diffraction calculations made by Goodbody (Abstr. 170 of 1959). It appears from these results that a mixed treatment leads to a smaller value of the response than that given by diffraction theory, and that the geometrical-optical treatment will give errors less than about 5% when the wave-front aberration exceeds about 1.5 times the Strehl type of tolerance.

535.32

6910 MEASUREMENTS OF THE DISPERSION OF AIR FOR WAVELENGTHS FROM 2302 TO 6907 Å. K.F.Svensson.

Ark. Fys., Vol. 16, Paper 35, 361-84 (1960).

Measurements of the dispersion of air have been carried out with a Jamin refractometer within the wavelength region from 2302 to 6907 A. The investigation has confirmed Edlen's formula for the dispersion of standard air, as far as the relative values are concerned; the differences are everywhere less than $\pm 2 \times 10^{-8}$ and exceed $\pm 1 \times 10^{-8}$ only in a few cases. The measurements have been made at different temperatures from 6°C to 23°C. According to the observations by Meggers and Peters in 1918, the effect of the temperature on the density factor of the refractivity would depend on the wavelength. It has not been possible to confirm any such dependence in the present investigation. In any case, a possible effect of this kind is less than one per cent of the value that Meggers and Peters have stated. When the air was dried with both silica gel and P_2O_5, the dispersion curve showed a steeper course than when the drying had been done only with P_2O_5. This may be explained by assuming that silica gel absorbs proportionately more nitrogen than oxygen. If this is the case, it would also cause the refractivities for air dried with silica gel to be lower than for air of normal composition at the same temperature and pressure. The reduction to standard conditions of wavelengths measured in non-standard air is discussed, and tables to be used for this reduction are given.

535.8 : 621.317.39

6911 LINEAR PHOTOMULTIPLIER BRIDGE CIRCUIT FOR THE MEASUREMENT OF SMALL CHANGES IN ABSORPTION. P.Hariharan and M.S.Bhalla.

Brit. J. appl. Phys., Vol. 10, No. 2, 89-90 (Feb., 1959).

The voltage applied to the two photomultipliers is controlled by means of a negative feedback loop so that the anode current of the monitor photomultiplier is held approximately constant. The ratio of the anode currents of the two photomultipliers is then linearly proportional to the transmission of the sample and is unaffected by fluctuations in the luminous output of the source and variations in the mains voltage. The sensitivity of the bridge remains constant, so that it is possible to estimate small changes in absorption directly from readings of the out-of-balance current.

535.8

6912 NOTE ON BAND TRANSMISSION IN MULTILAYER DIELECTRIC FILTERS. S.C.B.Gascoigne.

Austral. J. Phys., Vol. 12, No. 3., 296-8 (Sept., 1959).

A simple mathematical method is described for demonstrating the existence of pass and stop bands for multilayer dielectric filters. The method of Kronig—Penney for metal lattices is used. The simplified method of calculation described is applied to MgF_2—ZnS filters.

S.Tolansky

535.8

6913 ON THE APPLICATION OF ELECTRICAL IMAGE CONVERTORS AS IMAGE AMPLIFIERS. A.Reule.

Optik, Vol. 16, No. 11-12, 598-609 (Oct.-Nov., 1959). In German.

The image convertor is considered as a light-image intensifier and relations developed for the gain of the device. These are then applied for specific applications such as microphotography, macroscopic photography, visual observations in microscopy, etc. A table of brightness gain for various applications is given for the case of a television camera system as an image intensifier.

G.F.J.Garlick

535.8

6914 STUDY OF THE PRECISION OF LONGITUDINAL FOCAL SETTING. O.Dupuy.

C.R. Acad. Sci. (Paris), Vol. 250, No. 1, 97-9 (Jan. 4, 1960). In French.

The optimum exit-pupil diameter range was found to be 0.5-1.0 mm, over which the least perceptible defocusing of a line image was about $\lambda/16$ in optical path units; this corresponds to Strehl intensity 0.988. Possible reasons for the lower precision found outside this range of pupil diameter are discussed.

W.T.Welford

535.8

6915 A NEW METHOD OF LONGITUDINAL POISITIONING OF GREAT PRECISION. O.Dupuy.

C.R. Acad. Sci. (Paris), Vol. 250, No. 6, 1013-15 (Feb. 8, 1960). In French.

A system, based upon a Foucault test, transforms longitudinal focusing into the determination of photometric equality of two adjacent fields. Experiments show that this gives positional accuracy about 18 times better than would be expected from the depth of focus of the optical system.

R.W.Fish

535.8

6916 MANUFACTURE OF SHADOWGRAPH SLITS BY METAL EVAPORATION. E.A.Igel and T.E.Deem.

J. Opt. Soc. Amer., Vol. 50, No. 4, 394-5 (April, 1960).

Slits can be made by evaporating aluminium on to a glass base and masking with a fine tungsten wire. Practical details of the procedures are given. Comparisons show that the edge is superior to that given by a razor blade, being straight to within 1 μ. The width can be held within 2 μ in 80 mm length.

R.W.Fish

535.8

6917 HIGH TEMPERATURE MICROSCOPE STAGE. B.E.Sundquist.

Rev. sci. Instrum., Vol. 31, No. 4, 425-7 (April, 1960).

A microscope stage has been designed and constructed that permits microscopic observation of small particle specimens in the temperature range from room temperature to about 1200°C. Higher temperatures can be obtained with minor changes. The constructed stage contains four independent furnaces designed to permit accurate observation and control of specimen temperature even under conditions of rapid heating or cooling. Specimens are heated in easily interchangeable quartz crucibles by a Nichrome foil resistance wrapped on a small Alundum refractory tube.

535.8

6918 DIMENSIONS OF MICROSCOPE EYEPIECE GRATICULES. R.J.Hamilton.

Brit. J. appl. Phys., Vol. 10, No. 9, 428 (Sept., 1959).

For the microscopical counting of dust particles it is customary to use a reference graticule in the eyepiece. This paper describes a graticule used by the National Coal Board and gives the manufacturing tolerances on the grid dimensions and the diameters of the "globes and circles". R.W.Fish

535.8

6919 MEASUREMENT OF AXIAL AND OFF-AXIS GEOMETRICAL ABERRATIONS OF MICROSCOPE OBJECTIVES.

W.M.Vaidya and M.K.Sen Gupta.

J. Opt. Soc. Amer., Vol. 50, No. 5, 467-77 (May, 1960).

An apparatus incorporating several improvements for direct measurement of aberrations in microscope objectives is described. In principle, it is similar to that of Kingslake, who by shifting a pinhole across the apertures of a microscope objective measured the resultant transverse aberration from which spherical aberration could be readily calculated. By using a different pinhole system, accuracy of setting was improved, as also the brightness of image. Sensitivity of measurement of transverse aberration was increased by the addition of a separate magnifying system. The theory of measurements was extended to extra axial aberrations and the methods of measurements of spherical aberration, offence against sine condition, tangential and sagittal curvatures were described with aberration graphs for a typical microscope objective.

535.8

6920 TRANSMITTANCE MEASUREMENTS WITH AN INTERFERENCE MICROSCOPE.

C.J.Koester, H.Osterberg and H.E.Willman, Jr.

J. Opt. Soc. Amer., Vol. 50, N . 5, 477-82 (May, 1960).

Interference microscopy has proved useful for the detection and measurement of path differences between an object and its surround. For objects which absorb a fraction of the incident light an additional valuable measurement is the transmittance. Modifications of the AO Baker interference microscope which permit its use as a double-beam microphotometer are described. In some of the systems it is possible to make simultaneous readings of transmittance and optical path. Both visual and photoelectric detection are possible, and in most of the systems light of a finite range of wavelengths may be used.

535.8

6921 PARALLELISM TOLERANCES FOR BINOCULAR TELESCOPES. S.Dékány.

Acta tech. Hungar., Vol. 22, No. 3-4, 193-203 (1958). In German.

Previously proposed tolerances are summarized. The tolerances must depend on whether the error is in the vertical or the horizontal section and in the latter case on whether the eyes have to converge or diverge to fuse the images. A system of tolerances is given which takes account of these factors and also of the effect of the magnification of the telescope in increasing the error. W.T.Welford

535.8

6922 TWO NEW LIGHTWEIGHT MILITARY BINOCULARS. P.R.Yoder, Jr.

J. Opt. Soc. Amer., Vol. 50, No. 5, 491-3 (May, 1960).

Requirements exist within the military for improved binoculars providing the optical performance of existing standard instruments but with significantly reduced weight and bulk. Prototypes of a 6 × 20 minimum size binocular and of a 7 × 50 lightweight binocular developed by U.S. Army Ordnance in response to the foregoing requirements are now being evaluated by the U.S. Army to determine their suitability for field use. In this paper, the optical performance and physical characteristics of these new binoculars will be described.

535.33

6923 LINE WIDTHS IN PHOTOGRAPHIC SPECTROPHOTOMETRY. I. ON THE HISTORY OF PHOTOGRAPHIC PHOTOMETRY IN ASTRONOMY AND SPECTROSCOPY.

J.Junkes and E.W.Salpeter.

Ricerche spettrosc., Vol. 2, No. 6, 221-51 (March, 1959). In German, with English summary.

The development of image size methods and density of blackening measurements since 1958 is reviewed. G.F.Lothian

535.33

6924 APERIODIC AND PERIODIC INTERFERENCE MODULATION FOR SPECTOGRAPHIC PURPOSES.

L.Genzel.

J. molecular Spectrosc., Vol. 4, No. 3, 241-61 (March, 1960).

A general treatment of the methods of double-beam interference modulation (IM) is given, especially from the point of view of its application to spectroscopy. The authors are concerned with the distinction between periodic and aperiodic IM, depending on the variation of path difference being periodic or not. With equivalent operating conditions the two methods give indentical spectroscopic information. Especially in the far infrared and short microwave regions of the spectrum the IM seems to be one of the most efficient dispersion methods, and this is demonstrated by a record of the far infrared spectrum of the mercury arc emission and water vapour absorption.

535.33

6925 INFRARED SPECTROSCOPY OF SURFACE COATINGS IN REFLECTED LIGHT.

H.Dannenberg, J.W.Forbes and A.C.Jones.

Analyt.Chem., Vol.32, No. 3, 365-70 (March, 1960).

Infrared spectroscopy has been applied to organic coatings on metal substrates by the use of a reflection method. A commercial spectrophotometer is employed with a special reflectance accessory. The infrared light beam passes through the coating, is reflected from the substrate, passes throught the coating again, and finally enters th the spectrophotometer. This method produces good spectra of clear surface coatings, 0.1 to 0.5 mil thick, on flat surfaces of specularly reflective metals such as tin-plated steel, cold-rolled steel, aluminum, and brass. The method appears to be useful for qualitative and semiquantitative work. To make the reflection technique applicable to quantitative work, the influences of surface reflection and internal reflections must be considered. These effects can be made negligib by placing an antireflective cover plate over the specimen.

535.33

6926 TECHNIQUES FOR MEASURING THE INFRARED ABSORPTION SPECTRA OF FUSED SALTS.

J.Greenberg and L.J.Hallgren.

Rev. sci. Instrum., Vol. 31, No. 4, 444-5 (April, 1960).

The infrared absorption spectra of $NaNO_2$ and $LiNO_3$ in both the solid and liquid phase have been obtained by two methods. In one case the salt is supported in the interstices of a fine mesh platinum screen, and in the other case the measurements were made in a reflectance cell.

535.33

6927 SPECTROMETRY IN THE FAR INFRARED (50 TO 350 μ A.Hadni, C.Janot and E.Decamps.

Rev. Opt., Vol. 38, No. 9-10, 463-74 (Sept.-Oct., 1959). In French.

A brief description of an instrument with a plane grating and time constant of 100 sec, giving a resolution of 0.6-1 cm^{-1}. Theory is developed for the use of a grating in zero order as a long wave pass filter when the radiation is reflected in a plane (a) parallel (b) perpendicular to the rulings. Absorption curves are given for water vapour, SiO_2 mica, gypsum, several inorganic salts and some benzene derivatives; transmission limits of some plastics are given. G.F.Lothian

535.33

6928 GEOMETRICAL OPTICAL IMAGE FORMATION IN INFRARED SPECTROMETERS.

H.Yoshinaga, B.Okazaki and S.Tatsuoka.

J. Opt. Soc. Amer., Vol. 50, No. 5, 437-45 (May, 1960).

By using an electronic computer, rays were traced through six optical systems used in infrared sepctrometers to determine what broadening of the image takes place as a result of geometrical-optical aberrations. The data obtained indicate that Littrow instruments, using either a prism or a grating, form sharp images in a plane behind that of the entrance slit. Czerny—Turner optical arrangements form images in front of the entrance slit plane which are not so sharp as those formed by the Littrow instrument. Comparison of broadening due to geometrical-optical aberrations with that due to diffraction shows that in most cases the former is considerably less. The data presented show graphically the curvature of the image formed.

535.33

6929 POSSIBLE USES FOR A NEW TYPE OF MICROSPECTROPHOTOMETER.

A.Catino, A.Ceruti, P.Colombino and A.C.Levi.
Z. wiss. Mikr., Vol. 64, No. 6, 321-35 (Feb., 1960). In Italian.

Describes the development of the reflecting microscope with particular reference to biological applications, and a novel microspectrophotometer based upon a reflecting microscope which allows the determination of the absorption of cells of area ~ 1 μ^2 over the spectral range 220-1000 mμ. The quantity of material required is reduced by a factor of 10^4 compared with earlier methods. A new system of stabilized power supply is also shown. R.W.Fish

535.33

6930 EFFECTIVE LINE WIDTHS IN PHOTOGRAPHIC SPECTRAL PHOTOMETRY.

J.Junkes and E.W.Salpeter.
Ricerche spettrosc., Vol. 2, No. 5, 205-20 (Jan., 1958).

The width (w) of a photographic image increases with increasing intensity (I). Measurement of w with a suitable microphotometer may be used to determine I; the measurement is not so convenient as the usual determination of density of blackening, but is more sensitive at high intensities. G.F.Lothian

535.33

6931 A LIMIT ON THE ACCURACY OF PHOTOGRAPHIC RADIOMETRY.

J.A.Eyer.
Appl. Spectrosc., Vol. 14, No. 1, 4-7 (1960).

The granular nature of the photographic emulsion places a limit on the accuracy with which the density of a small area on the film can be defined. This in turn limits the accuracy with which incident exposures can be calculated when, for example, a spectrograph is employed for radiometric measurements. The quantity of information conveyed by a single density measurement is estimated for a particular emulsion and microdensitometer scanning aperture.

535.33

6932 OPTICAL CELL FOR THE OBSERVATION OF RAMAN SCATTERING IN GASES AT HIGH PRESSURES.

J.C.Stryland and A.D.May.
Rev. sci. Instrum., Vol. 31, No. 4, 414-15 (April, 1960).

For Raman spectroscopy of gases, intense illumination is required. The relatively low tensile strength of transparent materials has always severely limited such studies at high pressures. This paper describes a method by which use is made of the very high compressional strength of glass. The essence of the method is that the compressed gas is contained in an enclosed space outside a thick-walled glass tube; inside the tube a water-cooled mercury lamp is inserted. Pyrex tubes of 0.5 in. i.d. and 0.75 in. o.d. thus withstand pressures in excess of 3000 atm. The scattered light is observed through a conventional self-sealing window. High resolution Raman spectra have been obtained, for various simple gases, at pressures up to 2500 atm.

535.33

6933 AN ELECTRICAL SPECTROGRAPHIC CALCULATOR.

S.Epstein.
Appl. Spectrosc., Vol. 14, No. 1, 7-11 (1960).

An electrical circuit based on analogue computer principles has been designed that calculates spectrographic results directly from spectral line transmission values. It operates by solving the equation of the working curve of the element under analysis which must be a straight line in the range that includes all the percentage values of interest. If not straight, the intensity ratio of the analysis and standard lines can be calculated and percentage read from the working curve. Corrections for background and variation in emulsion response with wavelength can also simultaneously be included in the calculation.

535.33

6934 ON THE CIRCUIT FOR CONTINUAL MEASUREMENT OF LIGHT INTENSITY RATIO.

S.Minami.
Technol. Rep. Osaka Univ., Vol. 8, 337-46 (Oct., 1958).

The device described is intended for intensity ratio between two spectral lines. The circuit employs sawtooth voltages generated as a result of charging two small capacitors by the output currents of two photomultipliers and discharging them by two relay contacts. The slope of one sawtooth wave is proportional to the output current of one photomultiplier and its repetition period is so controlled as to be inversely proportional to the other. Accordingly, the ratio between the two output currents of the photomultipliers can be measured by a peak voltmeter composed of a sampling switch and an ordinary vacuum-tube voltmeter. The reproducibility and the deviation from linearity of the circuit is less than ±0.5% of the full output scale when the response time is a few seconds. The result of the measurement of the intensity ratio between the spectral lines of Mn and Fe emitted from steel samples excited by a high voltage spark discharge is given as an example.

535.33 : 621.389

6935 HIGH SPEED SPECTROGRAPH SHUTTER.

J.C.Camm.
Rev. sci. Instrum., Vol. 31, No. 3, 278-9 (March, 1960).

An electromechanical shutter is described which will open and close a 20 μ spectrograph slit in 5 μsec after a delay of 20 μsec. The shutter incorporates a movable slit which is propelled across the stationary spectrograph slit by the thermal expansion of a Joule-heated hairpin-shaped Nichrome wire.

535.33

6936 SOME TECHNIQUES FOR RECORDING AND MEASURING TIME-RESOLVED SPECTRA.

A.H.Gabriel.
J. sci. Instrum., Vol. 37, No. 2, 50-3 (Feb., 1960).

Methods are considered of recording the time-variation of the spectra of microsecond phenomenon. An apparatus is described employing a rotating mirror time-resolving device before the slit of a quartz photographic spectrograph. Writing speeds of up to 5.1 mm/μs are obtained. Consideration of possible calibration techniques involves some preliminary results on reciprocity law failure at very short exposure times. A pulsed calibration source is described in which a continuum at 26 000°K is maintained for 15 μs, and this is used to provide an absolute calibration of the records.

535.33

6937 WAVELENGTH MEASUREMENTS IN THE SPECTRUM OF A MERCURY ARC AT DIFFERENT VOLTAGES.

I.Johansson and K. F.Svensson.
Ark. Fys., Vol. 16, Paper 34, 353-60 (1960).

The wavelengths of the lines emitted by a mercury arc when it is run at different voltages (20 and 70 volts) have been measured. The shifts of the various lines have been derived by comparing the results obtained at the two voltages with the results from some earlier investigations where the shifts may be assumed to be negligible. The actual wavelengths emitted by the lamp at 70 volts were needed for an investigation of the dispersion of air. See Abstr. 6910.

535.33

6938 VIBRATION—ROTATION STRUCTURE IN ABSORPTION BANDS FOR THE CALIBRATION OF SPECTROMETERS FROM 2 TO 16 MICRONS.

E.K.Plyler, A.Danti, L.R.Blaine and E.D.Tidwell.
J. Res. Nat. Bur. Stand., Vol. 64A, No. 1, 29-48 (Jan.-Feb., 1960).

Suitable bands of common gases have been tabulated and remeasured wherever necessary from 2 to 16 μ to obtain an accuracy of about 0.03 cm^{-1} throughout the region and to provide good calibrating points at frequent intervals. Some 600 rotation—vibration lines are illustrated in 20 spectrograms and wavenumbers are listed in companion tables with considerable intercomparison with worthy data obtained in other laboratories. The absorption bands were remeasured or calibrated by using either a precisely graduated grating circle or standard atomic lines with the fringe system formed by a Fabry—Perot interferometer. Characteristic features of the individual bands are discussed briefly and references to other publications are given. The substances used for calibration include H_2O, CO_2, CO, HCl, HBr, NH_3, C_2H_2, CH_4, N_2O, and polystyrene film.

PHYSICAL OPTICS

(Luminescence is included under Solid-State Physics; Liquid State, or Gaseous State)

535.39

6939 OPTICS OF LIGHT-SCATTERING FILMS. STUDY OF EFFECTS OF PIGMENT SIZE AND CONCENTRATION.

R.H.Harding, B.Golding and R.A.Morgen.
J. Opt. Soc. Amer., Vol. 50, No. 5, 446-55 (May, 1960).

Optimization of enamel formulations to achieve desired optical film properties at minimum cost is a subject which has received considerable attention and made but little progress in the paint industry. Inquiries have not progressed as far as might be expected because of the cost of the extensive and precise laboratory work required presently. An extension of theory to practice was undertaken in this work. When thoroughly investigated, the new concepts developed should permit computation of film optics rapidly and with low investment. In beginning the project, suitably reproducible laboratory techniques were developed and their precisions were estimated. It was then determined that pigment size distribution, pigment concentration, and distribution of wavelength of light interact to produce situations that have apparently not previously been recognized. Magnitudes of these effects are reported for a system of anatase-pigmented alkyd enamels, and the exploratory experimental procedures are outlined. Further work along these lines is encouraged, since the mathematical functions involved have not yet been completely defined for the general case.

535.39

6940 USE OF CHEBYCHEV [CHEBYSHEV] POLYNOMIALS IN THIN FILM COMPUTATIONS. K.D.Mielenz.

J. Res. Nat. Bur. Stand., Vol. 63A, No. 3, 297-300 (Nov.-Dec., 1959).

From Herpin's (Abstr. 3492 of 1947) expression for the mth power of a multilayer matrix, very simple closed formulae are derived for the matrices and optical constants of any multilayer with a periodic structure. According to Epstein's theorem (Abstr. 764 of 1953), any symmetrical multilayer is equivalent to a fictitious monolayer. A simple expression for the equivalent index and thickness of this monolayer is deduced for the case of a periodic and symmetrical sequence of equally thick films. As compared with any other method of numerical computation, the suggested formulation provides a considerable saving of time and work. In a numerical example given, this saving amounts to about 80%.

535.39

6941 SIMPLE METHOD OF DETERMINING THE THICKNESS OR THE REFRACTIVE INDEX OF THIN FILMS.

K.V.Krishna Rao.

Amer. J. Phys., Vol. 28, No. 5, 447-9 (May, 1960).

A simple method of determining the thickness or the refractive index of thin films using double-slit Fraunhofer diffraction fringes is described. To illustrate the method, the thickness of grey photographic film and the refractive index of a cellulose acetate film have been determined.

535.41

6942 THE INTERFERENCE PHENOMENA OF LIGHT AT VERY LOW INTENSITIES. L.Jánossy and Z.Náray.

Acta phys. Hungar., Vol. 7, No. 4, 403-25 (1957).

An interference pattern is obtained with a Michelson interferometer; the intensity distribution in the pattern is determined by counting the rate of photons by means of a photomultiplier. It is shown that the pattern obtained for very low intensities of light does not differ outside the margin of experimental error from the pattern obtained for normal intensities. At low intensities, about 10^6 phophotons/sec enter the interferometer; thus on the average, at any given time, less than one photon is contained inside the interferometer.

535.41

6943 FRACTIONAL ORDER SLIDE RULE FOR INTERFEROMETRIC LENGTH MEASUREMENT. K.H.Hart.

Rev. sci. Instrum., Vol. 31, No. 4, 438-40 (April, 1960).

A description is given of a slide rule of special design for use with the method of exact fractions in interferometry. The instrument computes lengths from measured excess fraction orders.

535.42

6944 A NOT HITHERTO CONSIDERED CASE IN WHICH KIRCHHOFF'S FORMULATION FOR THE APPROXIMATE DESCRIPTION OF DIFFRACTION PHENOMENA FAILS.

A.Rubinowicz.

Acta phys. Polon., Vol. 17, No. 1, 13-20 (1958). In German.

It is shown that Kirchhoff's method becomes inappropriate if the diffracting aperture has a form such that there exists a half-ray originating at the light source which passes exactly, or approximately, through two points which lie on different sides of the diffracting aperture. P.Roman

535.41

6945 A NEW INTERFEROMETRIC METHOD OF MEASURING THE DISPERSION IN LIQUIDS. I.N.Shklyarevskii.

Optika i Spektrosk. Vol. 6, No. 6, 780-3 (June, 1959). In Russian.

Describes a modification of the author's (Abstr. 827 of 1955) interferometric method for measuring the dispersion in liquids in the visible and ultraviolet regions. The effect of the phase-shift dispersion is allowed for in the same way as in measurement of the thickness of thin films. This increases the accuracy of the measurements. A.Tybulewicz

535.42

6946 ELEMENTARY DIFFRACTION THEORY OF ZONE PLATES. M.Sussman.

Amer. J. Phys., Vol. 28, No. 4, 394-8 (April, 1960).

After a short introduction in which the notion of half-period zones is recalled, the axial intensity distribution of a zone plate, in the first-order approximation, is derived from diffraction theory. Its focal properties are then studied in some detail, including off-axis effects. Similarities in the axial distribution patterns for a zon plate and Fraunhofer patterns for a linear grating are discussed, anc finally some possible applications and practical difficulties are presented.

535.42

6947 DIFFRACTION THEORY FOR IMAGES OF DISK-SHAPED PARTICLES WITH KÖHLER ILLUMINATION.

H.Osterberg and L.W.Smith.

J. Opt. Soc. Amer., Vol. 50, No. 4, 362-9 (April, 1960).

The distribution of the time-averaged density in the diffraction image of thin disk-shaped particles is derived from the diffraction theory of optical instruments for cases in which the particle is focused sharply by objectives of the idealized Airy type in a microscope adjusted for Köhler illumination and illuminated by unpolarized monochromatic light. Whereas the diffraction integrals are stated for any numerical aperture of the substage condenser, the solution is restricted to cases in which the numerical aperture of the substage condenser or illuminating system is set equal to the numerical aperture of the objective.

535.42

6948 DIFFRACTION IMAGES OF DISK-SHAPED PARTICLES COMPUTED FOR FULL KÖHLER ILLUMINATION.

L.W.Smith.

J. Opt. Soc. Amer., Vol. 50, No. 4, 369-74 (April, 1960).

Energy densities in the diffraction images of single uniform nor self-luminous disk-shaped particles are computed for cases in which the image of the source of light just fills the exit pupil of the object lens in a microscope adjusted for Köhler illumination. Curves are presented for several examples, including holes in an opaque screen and opaque particles in a transmitting surround. Two functions are developed and a table of values for each is given from which it is possible to calculate curves for many other examples. The functions are tabulated for particles 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4, and 2.0 Airy units in radius. A hole 2 Airy units in radius in an opaque screen is found to produce a diffraction image the central energy density of which is less than 90% of what would be produced at the image plane if no screen were present. Similarl the energy density at the centre of the image of an opaque particle 2 Airy units in radius is found to be nearly 5% of the energy density in the image of the distant surround. Opaque particles about 1 Airy unit in radius, which previously were known to produce images containing a secondary Airy disk when narrow-coned, axial illumination is used, are found both experimentally and theoreticall to produce images retaining that feature when the numerical aperture of the condenser equals that of the objective.

535.42 : 538.56

6949 A NOTE ON DIFFRACTION BY A HALF PLANE. W.E.Williams,

Canad. J. Phys., Vol. 38, No. 3, 507-10 (March, 1960).

The known solution for diffraction at a perfectly conducting half plane of electromagnetic radiation from a line source parallel to the edge is obtained; by assuming the correct form of the solutior near the edge and using the reciprocity condition the analysis is considerably simplified. W.T.Welforc

535.43

6950 MOLECULAR INTERACTION IN THE CLASSICAL THEORY OF LIGHT SCATTERING. S.Kielich.

Bull. Acad. Polon. Sci. Ser. Sci. math. astron. phys., Vol. 6, No. 3, 215-21 (1958).

The general form of the effect of molecular interaction on light-scattering is derived by a method described in Abstr. 6813 (960). It is obtained in terms of a correlation factor for molecular orientations, whose value for several molecules is computed from the depolarization of scattered light, from the Cotton–Mouton constant, and from the Kerr constant. A.R.Stokes

535.43 : 532.7

6951 LIGHT SCATTERING BY COMMERCIAL SUGAR SOLUTIONS. C.J.Rieger and F.G.Carpenter.

. Res. Nat. Bur. Stand., Vol. 63A, No. 3, 205-13 (Nov.-Dec., 1959).

Using a direct measure of scattered light, it was found that commercial sugar solutions scatter light predominantly in a forward direction. The scattering at angles less than 30° was as much as one hundred times that at right angles to the incident beam. It was found that the light scattering by commercial sugar solutions is inversely dependent on wavelength to a power of between 2 and 3, and that severe multiple scattering occurs when the turbidity of the solution is larger than 2×10^{-1} cm^{-1} at 436 mμ. The scattering of commercial sugar solutions is compared with that of highly purified sucrose. A method is discussed that will enable a good approximation of the turbidity of commercial sugar solutions to be made from a single forward scattering measurement at an angle of about 0° with respect to the incident light beam. A correction for scattered light in transmission measurements of these solutions is also introduced.

535.5

6952 INFRARED POLARIMETRY.
R.Duverney and A.M.Vergnoux.

. Phys. Radium, Vol. 18, No. 8-9, 527-36 (Aug.-Sept., 1957).
n French.

Review article.

535.5

6953 POLARIZER FOR THE FAR-INFRARED REGION.
A.Mitsuishi, Y.Yamada, S.Fujita and H.Yoshinaga.

. Opt. Soc. Amer., Vol. 50, No. 5, 433-6 (May, 1960).

Pile-of-plates polarizers made of thin sheets of polyethylene were constructed for use in a far-infrared spectrograph. The degree of polarization with 15 sheets is more than 97% except in the spectral region in which constructive interference of light reflected from both surfaces of a sheet increases the transmission of s-component and decreases the polarization. The transmission is more than 75% of the incident plane polarized light. Limitations due to interference were decreased by combining polyethylene sheets of two thicknesses. The reflectivities of a filter grating, dispersion gratings, and reststrahlen crystals were measured for s and p plane polarized radiation.

535.55

6954 EXPERIMENTAL STUDY BY A NEW METHOD OF THE ABSOLUTE RETARDATION IN ELECTRIC BIREFRINGENCE OF LIQUIDS. ELECTROSTRICTION. J.Minard.

.R. Acad. Sci. (Paris), Vol. 250, No. 4, 694-6 (Jan. 25, 1960).
In French.

A method of determination of $(n_e - n)$ and $(n_0 - n)$ for a liquid is described, where n_e and n_0 are the refractive indices for the extraordinary and ordinary rays respectively when the liquid is made doubly refracting by the application of an electric field and n is the refractive index without the field. A square wave pulse is applied to the plates of a Kerr cell and for the duration of the pulse a source of polarized light is turned on. The values of $(n_e - n)$ and of $(n_0 - n)$ are found by using a Jamin interferometer. Potentials of 28 kV are used and the pulses have a rise time of the order of microseconds and a duration of between 1 and 50 μsec. Fringes allowing an accuracy of measurement of λ/20 are visible. A short discussion on electrostriction is given. H.G.Jerrard

535.56 : 539.19

OPTICAL ROTATION OF ORIENTED HELICES.
See Abstr. 6000

COLORIMETRY . PHOTOGRAPHY

77 : 539.2 : 537.311

6955 HALL MOBILITY OF HOLES IN AgBr.
R.C.Hanson and F.C.Brown.

J. appl. Phys., Vol. 31, No. 1, 210-11 (Jan., 1960).

In order to help clarify the mechanism of the photographic process, with particular reference to hole conduction, the Hall effect has been studied in high purity AgBr crystals surrounded by gaseous bromine. The effect was studied by an a.c. technique between 25° and 150°C, measuring a Hall voltage about two orders of magnitude greater than the smallest voltage observable above noise. A value of 1.7 ± 0.5 cm^2 volt^{-1} sec^{-1} was found for the Hall mobility of the holes introduced by the bromine, corresponding to a carrier density of about 10^{12} cm^{-3} for a bromine pressure of 200 mm of Hg. The electron mobility is about 40 times greater under the same conditions and decreases less steeply with increasing temperature. I.Cooke

77 : 539.2

EXPERIMENTS ON THE INFLUENCE OF STRUCTURAL SURFACE DEFECTS ON THE DEVELOPABILITY AND LIGHT SENSITIVITY OF SILVER HALIDE SINGLE CRYSTALS.
See Abstr. 4292

77

6956 RECIPROCITY FAILURE IN ZnO AND Se.
J.Kostelec.

J. appl. Phys., Vol. 31, No. 2, 441-2 (Feb., 1960).

Using a charged layer of xerographic ZnO in a silicone resin, and plotting intensity of light against exposure (light intensity × time), required to halve the surface charge, reciprocity failure is observed. This is mostly on the high intensity side, while for Se failure occurs at both high and low intensities. Incandescent light with filters was used. S.T.Henderson

77 : 535.41

ACCURACY OF THE DUPLIGRAM METHOD FOR TESTING PHOTOGRAPHIC OBJECTIVES. See Abstr. 5143

77 : 535.24

DENSITOMETER WEDGE FOR MEASUREMENTS AT LOW OPTICAL DENSITIES. See Abstr. 6902.

77 : 539.2 : 537.2 : 621.319

"ELECTROFAX" — REVIEW OF PROPERTIES.
See Abstr. 4387

77

6957 UTILIZATION OF THE PRINCIPLE OF CONTACT PHOTOGRAPHY IN THE STUDY OF FEEBLE LIGHT FLUXES. I.V.Volkov, V.F.Esipov and P.V.Shcheglov.

Dokl. Akad. Nauk SSSR, Vol. 129, No. 2, 288-9 (Nov. 11, 1959). In Russian.

The improved device for contact photography of faintly-luminous objects (the photo-contact tube) consists of a vacuum bulb containing a semi-transparent photocathode, electron-optical parts and a fluorescent screen on the 20-30μ mica sheet which forms the back wall of the device and to which the emulsion is pressed, the contact being established by means of a suitable immersion medium. This tube (with a O-Cs photo-cathode) was used for photographing the spectra of the night-sky glow. It is claimed that the sensitivity of the new device is ~10 times that of the conventional device (electron-optical transducer with optical transfer). F.Lachman

77

6958 STROBOSCOPIC RADIOGRAPHY WITH A LINEAR ACCELERATOR. B.J.Vincent.

Brit. J. appl. Phys., Vol. 11, No. 3, 132-5 (March, 1960).

High-definition stroboscopic radiographs of an internal combustion engine have been obtained. Efficient use of the large accelerator output has enabled fine-grain film and a large film-focus distance to be used. The radiographs have been used to check the performance of the engine valves under running conditions. Comparison is made with stroboscopic radiography using a betatron. Methods of synchronization and some possible used of stroboscopic radiography are briefly discussed.

HEAT . RADIATION

536.2 : 532.5

6959

SOME LAWS OF THE FLOW PROCESSES OF SIMULTANEOUS HEAT AND MASS EXCHANGE IN HETEROGENEOUS SYSTEMS. L.D.Berman.

Zh. tekh. Fiz., Vol. 29, No. 1, 94-106 (Jan., 1959). In Russian. English translation in: Soviet Physics—Technical Physics (New York) Vol. 4, No. 1, 82-92 (Jan., 1959).

For previous work, see Zh. tekh. Fiz., Vol. 20, No. 11, 2617 (Nov., 1958). Studies the influence, qualitative and quantitative, that the transverse flow has on the coefficients of heat and mass transfer.

536.2

6960

ON A FREE BOUNDARY VALUE PROBLEM FOR THE HEAT EQUATION. W.T.Kyner.

Quart. appl. Math., Vol. 17, No. 3, 305-10 (Oct., 1959).

Miranker's problem [Quart. appl. Math., Vol. 16, No. 2, 121-30 (July, 1958)] interpreted physically has the restriction that the liquid-solid metal interface must be moving before the mathematical model can apply. The purpose of the present mathematical discussion is to present a constructive existence and uniqueness theorem which is not subject to the restriction. S.Weintroub

536.2

6961

STEADY-STATE TEMPERATURE DISTRIBUTION IN SOLIDS UNDERGOING CERTAIN CHANGE OF PROPERTY. T.J.Mirsepassi.

Brit. J. appl. Phys., Vol. 10, No. 12, 538-42 (Dec., 1959).

In the design of high-temperature equipment, two problems are often encountered: (1) determining the effect of slow changes of the thermal conductivity (which can occur as a result of chemical and/or mechanical factors) on the thermal behaviour of the equipment, and (2) finding the most efficient combination of materials for the design of the equipment when several materials are available. Both of these problems are customarily solved by trial-and-error techniques. It is first shown that the temperatures before and after such changes of the thermal conductivity are related by simple linear equations. It is demonstrated that the process of trial-and-error in the solution of the above problems can be entirely eliminated by the use of these simple equations.

536.2 : 539.17

6962

TEMPERATURES, THERMAL STRESSES AND DISPLACEMENTS IN SOLID URANIUM DIOXIDE RODS.

J.P.Ellington.

Brit. J. Appl. Phys., Vol. 11, No. 1, 33-5 (Jan., 1960).

Expressions are derived for the temperatures, stresses and displacements in a solid uranium dioxide fuel rod, the thermal conductivity of which decreases exponentially with temperature. Graphs of the temperatures and displacements are given, and calculation shows that the rod will fracture when the centre-to-surface temperature drop exceeds 80-90°C.

536.2

6963

HIGH ALLOY STEELS FOR USE AS A THERMAL CONDUCTIVITY STANDARD. R.W.Powell and R.P.Tye.

Brit. J. appl. Phys., Vol. 11, No. 5, 195-8 (May, 1960).

An absolute longitudinal steady state heat flow method is described for the determination of the thermal conductivity of a bar of Macloy G steel over the range 0 to 180°C. The results of this method are in good agreement with those of a comparative method against Armco iron that is used for the range 300 to 800°C, and values are quoted for the full range which are believed to be accurate to about ±2%. Comparison is made with some previous determinations on a sample of Era ATV steel. These steels are suggested as suitable for use as standard materials for comparative thermal conductivity determinations on metals of low conductivity.

536.2

6964

A SIMPLE COMPARISON METHOD FOR THE MEASUREMENT OF THE THERMAL CONDUCTIVITY OF SMALL METAL SAMPLES. W.Fritz and K.H.Bode.

Z. angew. Phys., Vol. 12, No. 3, 121-4 (March, 1960). In German.

The test piece and comparison standard consist of metal cylinders of 20 mm diameter and 18 mm height placed vertically and in contact, with the test piece uppermost. The top end face is attached to a heater and the bottom end face to a cooled block. By using an oil film between the faces in contact and an insulated heated surround a uniform temperature gradient is obtained along the cylinders. T standards consisted of the materials used in Abstr. 2263 of 1959. The construction and use of the apparatus are fully described. Tes described show that with care the thermal conductivity may be measured with an error of not greater than ±3%. S.Weintrou

536.2 : 539.1

6965

THERMAL CONTACT RESISTANCE BETWEEN CYLINDRICAL METALLIC SURFACES.

E.Brutto, I.Casagrande and G.Perona.

Energia nucleare, Vol. 6, No. 8, 532-40 (Aug., 1959).

The paper gives details of the apparatus and method, of an experiment for comparing different cladding processes from the aspect of thermal conductivity. Results are quoted using aluminiu as the cladding metal with copper as the fuel element.

E.G.Knowl

536.

6966

CONCERNING THERMAL JUNCTION RESISTANCE IN THE A.F. JOFFE METHOD FOR MEASUREMENT OF THERMAL CONDUCTIVITY. W.F.G.Swann.

J. Franklin Inst., Vol. 268, No. 4, 294-6 (Oct., 1959).

In a previous paper Abstr. 9548 (1959) an expression was given showing that thermal junction resistance at the hot end of the specimen does not affect the determination of the quantity λ which occurs in the exponential decay of temperature with time function. A formal derivation of the expression is given and a correction to equation 25 of the work is pointed out. S.Weintro

536.2

6967

TRANSIENT TEMPERATURES ATTAINED IN DISK BRAKES. T.P.Newcomb.

Brit. J. appl. Phys., Vol. 10, No. 7, 339-40 (July, 1959).

A solution is given to the problem of heat conduction in a composite solid consisting of three infinite slabs between parallel plane boundaries, when the two interfaces are subjected to a therm flux which decreases linearly with time, whilst at the two outer pla surfaces there is no flow of heat. This solution is applied to the problem of determining the transient temperatures reached at the friction surfaces of a disk brake when a constant deceleration is produced during braking. Typical values of the temperature of the surface of a disk obtained by use of a radiation pyrometer with a rapid response are given, and comparisons made with the mean temperatures determined theoretically.

536.

6968

HEAT CONDUCTION FROM A CYLINDRICAL SOURC WITH INCREASING RADIUS. H.R.Bailey.

Quart. appl. Math., Vol. 17, No. 3, 255-61 (Oct., 1959).

The problem of the heat conduction in an infinite homogeneous medium from the surface of a cylinder of finite length whose radiu is increasing with time is considered. The differential equation describing the problem is set up and the Green's function method i applied to obtain a solution in the form of an integral. The case where the source is moving at a constant velocity with no vertical losses is treated by obtaining a limiting value of the integral, and an explicit evaluation of the integral solution is obtained for the ca of the radius increasing at a variable velocity. S.Weintro

536.

6969

THE RADIAL FLOW OF HEAT IN AN INFINITE CYLINDER. T.P.Newcomb.

Brit. J. appl. Phys., Vol. 9, No. 11, 456-8 (Nov., 1958).

A solution is given to the problem of heat conduction in a soli cylinder of infinite length, the surface of which is subjected to a thermal flux which decreases linearly with time. This solution m be used to determine the transient temperatures occurring at the interface or at any point within two concentric cylinders which ar in contact, one of which is rotating relative to the other. The solu tion is of importance as it permits calculation of the temperature reached in the lining and drum of a band brake during a brake app cation. Typical curves illustrating the agreement between transie temperatures determined theoretically and experimentally at the surface of the cylinder are given.

53

6970

EFFECT OF NON-UNIFORM HEATING OF A TUBE'S PERIMETER ON THE MAGNITUDE OF THE CRITICA HEAT FLOW. M.A.Styrikovich and I.L.Mostinskii.

Dokl. Akad. Nauk SSSR, Vol. 127, No. 2, 316-19 (July 11, 1959). In Russian.

Results are described and graphed of experiments carried out h models of boiler tubes of irregular section, the conditions of e experiments being as follows: pressure, 26, 100 and 180 atm solute); flow rates, from 200 to 2000 kg m^{-2} sec^{-1}; steam con- t (x), from 0 to 1. The heating was effected by passing 50 c/s . through the tube body (current density <50 A mm^{-2}). The fol- wing empirical formula is proposed for the critical heat flow (heat w at which nuclear boiling passes into film boiling):

$$q^{\max}_{cr}/q^{0}_{cr} = 1 + 12\,(1 - 0.4x)[(q_{\max}/\bar{q}) - 1]/Pe_0^{0.25}\,Pr_0$$

ere $q^{\max}_{cr}$ and q^{0}_{cr} are the local values of the critical heat flow in e place where the boiling crisis arises (the greatest wall thickness), the irregular and regular section tube, respectively, and Pe_0 d Pr_0 are the Peclet and Prandtl numbers. F.Lachman

536.2

6971 HEAT TRANSFER IN LOOSE MATERIALS.

H.Gläser.

rch. tech. Messen, No. 285 (Ref. V 23-2) 199-202 (Oct., 1959). German.

A detailed description is given of the use of the regenerator and s associated equipment. The results are best represented in nensionless form as a relation between the Nusselt and Reynolds mbers, and a plot of the relation between the two numbers for aschig ring ballast is given. S.Weintroub

536.2 : 532.5

6972 LAMINAR HEAT TRANSFER BETWEEN PARALLEL PLATES WITH AN UNSYMMETRICALLY PRESCRIBED EAT FLUX AT THE WALLS.

R.D.Cess and E.C.Shaffer.

pl. sci. Res. A, Vol. 9, No. 1, 64-70 (1959).

The first four odd eigenvalues and constants, as well as asymp- ic expressions for these quantities, are presented for heat trans- to laminar flow between parallel flat plates with unsymmetrical at rates per unit surface area prescribed at the walls.

536.2 : 532.5

6973 HEAT TRANSFER IN LAMINAR FLOW BETWEEN PARALLEL PLATES AT SMALL PÉCLÉT NUMBERS.

.C.Agrawal.

pl. sci. Res. A, Vol. 9, No. 2-3, 177-89 (1960).

The problem of heat transfer for laminar flow between two in- nite parallel plates, $y = \pm l$, $x \le 0$, kept at a constant temperature , and $y = \pm l$, $x \ge 0$, kept at a different constant temperature T_S, is rmulated, taking into account the effect of heat diffusion on the cident fluid. This is achieved by obtaining solutions of the energy uation for the regions $x \le 0$ and $x \ge 0$ and by imposing continuity nditions on the temperature and its derivative at the junction = 0. It is found that at small Péclét numbers, the incident tempera- re is affected by the diffusion of heat from the right ($x > 0$) to the t ($x < 0$). This effect is negligible for large Péclét numbers e ~ O(1000)]. Further, the temperature of the incident fluid at = 0 cannot be taken as constant (= T_0) if the heat generated by scous dissipation is taken into consideration. Detailed solutions e given for Pe = 1. Mean-mixed temperatures and local Nusselt mbers for $x > 0$ and $x < 0$ are tabulated and shown graphically.

536.2

6974 STEADY TEMPERATURE FIELD IN A SEMI-INFINITE COMPOSITE PLATE.

V.Vodička.

ppl. sci. Res. A, Vol. 9, No. 2-3, 190-6 (1960).

Considers the temperature distribution in a semi-infinite plate mprising n homogeneous isotropic layers with thermal conductivi- es λk (k = 1,2......,n), the upper and lower faces being kept at pre- ribed temperatures, and the remaining boundary being at zero mperature.

536.2 : 532.5

6975 HEAT TRANSFER BY LAMINAR FLOW FROM A ROTATING SPHERE.

S.N.Singh.

ppl. sci. Res. A, Vol. 9, No. 2-3, 197-205 (1960).

The heat transfer problem for the flow of an incompressible iscous, heat-conducting fluid, due to uniform rotation about the iameter of a sphere, which is kept at a constant temperature, is olved, taking account of viscous dissipation. Due to inflow at the oles, the cooler liquid is drawn from infinity towards the rotating phere and this causes a lowering of the temperature there. After owing in the boundary layer of the sphere, the liquid gets heated p and causes a rise in temperature near the equator. Numerical results are given in case of water (Prandtl number = 5), and it is found that the isothermals are surfaces of revolution flattened at the poles and elongated near the equator. The thermal and the velocity boundary layers turn out to be of the same order of magnitude.

536.2

6976 THE EFFICIENCY OF A LONGITUDINAL FIN WITH VARIATION OF THE HEAT-TRANSFER COEFFICIENT ALONG THE FIN LENGTH.

G.Melese.

J. nuclear Energy, Vol. 5, No. 3-4, 285-300 (1957). In French.

With a few simplifying assumptions, it is possible to compute the efficiency of longitudinal fins of practically arbitrary shape even when the heat-transfer coefficient is significantly greater at the tip than at the root of the fin. In such a case the efficiency is decreased compared to the case of a constant heat-transfer coefficient (equal to the mean value of the variable coefficient) and this decrease is comparatively larger for poor fin efficiencies. In principle, this decrease may reach 10 to 20% of the "classical" fin efficiency; but in practice, it may even be larger, when the fins are very close to each other, for instance. This case often happens in the cooling of nuclear reactors by a gas, since the heat fluxes are important and the temperatures and coolant cross-section are limited. Nevertheless, the assumption of a constant coefficient is usually justified, since the fin efficiency is often only 10% or less smaller than the value found by the "classical" method (in most practical cases of rather efficient fins), in spite of the fact that experiments show the variation of the heat-transfer coefficient along the fin very seldom to be negligible.

536.2 : 532.5

6977 HEAT TRANSFER AND FRICTION IN TURBULENT VORTEX FLOW.

F.Kreith and D.Margolis.

Appl. sci. Res. A, Vol. 8, No. 6, 457-73 (1959).

Presents experimentally measured heat transfer and friction coefficients for air and water flowing through a pipe with several types of inserts designed to induce a swirl in the flow. It was observed that inside-surface heat transfer coefficients in swirling flow can, under favourable conditions, be at least fourtimes as large as heat transfer coefficients at the same mass flow rate in purely axial flow. At the same time the pumping power per unit rate of heat transfer can be reduced. The increase in heat transfer coefficients was found to depend on the degree of swirl and on the density or temperature gradient. However, at comparable Reynolds numbers and swirling motions the heat transfer coefficients for air were found to be smaller than the coefficients for water. The reason for this difference is not definitely known, but the phenomenon is qualitatively compatible with that causing the cooling effect in Ranque—Hilsch vortex tubes. The observed phenomena are analysed qualitatively and it is shown that they are primarily the result of a centrifugal force which induces a radial inward motion of warmer fluid and a radial outward motion of cooler fluid. The application of vortex flow to boiling heat transfer and other high heat flux systems is discussed briefly.

536.2

6978 HEAT TRANSFER BY LIQUIDS CARRIED ALONG IN A TURBULENT GAS FLOW (THEORETICAL STUDY).

P.Perroud and A. de La Harpe.

C.R. Acad. Sci. (Paris), Vol. 249, No. 23, 2503-5 (Dec. 9, 1959). In French.

In the case considered the liquid forms a film adhering to the walls of a cylindrical heating tube. A formula is derived for the ratio of the heat transfer coefficient from wall to gas to the coefficient for turbulent convection of the gas alone. R.Berman

536.2

6979 THE HEAT LOSS FROM NON-BOILING WATER AT HIGH HEAT FLUXES.

V.V.Yakovlev.

J. nuclear Energy, Vol. 5, No. 3-4, 421-3 (1957). English translation of article in Atomnaya Energiya, Vol. 2, No. 2, 179-80 (1957).

Some preliminary results are given of experiments on heat loss from non-boiling water flowing turbuently in pipes, for large heat fluxes. The empirical formula proposed by Micheev [Iz. Akad. Sci. U.S.S.R. No. 1, (1952)] gives the most reliable representation for calculations of heat loss under these conditions. This formula is

$$Nu_B = 0.21\,Re_B^{0.8}\,Pr_B^{0.43}\left(\frac{Pr_B}{Pr_W}\right)^{0.25}$$

where Nu_B, Re_B, Pr_B and Pr_W are the Nusselt, Reynolds and Prandtl numbers. The suffixes B and W denote the parameters taken at the mean temperatures of the liquid and of the walls respectively.

536.2 : 532.1

A RELATIONSHIP FOR THE VISCOSITY AND THERMAL CONDUCTIVITY OF LIQUIDS AND GASES. See Abstr. 6734

536.2 : 532.1

6980 VISCOSITY AND THERMAL CONDUCTIVITY OF LIQUID BORON TRIFLUORIDE. A.N.Spencer and M.C.J.Todd.

Brit. J. appl. Phys., Vol. 11, No. 2, 60-4 (Feb., 1960).

The normal liquid range of boron trifluoride is -100° to -127°C. Conventional methods have been adapted to measure viscosity and thermal conductivity throughout this range of temperature, and experimental results are presented.

536.2

6981 THE DEPENDENCE OF THE THERMAL CONDUCTIVITY OF GASES AND LIQUIDS ON THE PRESSURE AND TEMPERATURE. Z.Losenický.

Czech. J. Phys., Vol. 9, No. 2, 258-9 (1959). In German.

It is stated that the isothermals of the thermal conductivity of various gases and liquids plotted from published experimental data are similar to those for the viscosity. Thus, the quoted analytical expression for the isothermal is similar to that for the viscosity given by Brablc (Abstr. 9278 of 1959). The differences between the expressions and the meaning of the symbols involved are briefly discussed. S.Weintroub

536.2

6982 THERMAL CONDUCTIVITY OF GAS MIXTURES IN CHEMICAL EQUILIBRIUM. II. R.S.Brokaw.

J. chem. Phys., Vol. 32, No. 4, 1005-6 (April, 1960).

For Pt 1, see Abstr. 7810 (1957). The expression for the thermal conductivity is presented in a simpler and less restrictive form. This new form is shown to be equivalent to the previous equations.

536.2

6983 ON THE BOUSSINESQ APPROXIMATION FOR A COMPRESSIBLE FLUID. E.A.Spiegel and G.Veronis.

Astrophys. J., Vol. 131, No. 2, 442-7 (March, 1960).

The full, non-linear equations governing thermal convection in a compressible fluid have been re-examined in order to determine the conditions under which the Boussinesq approximation is applicable. These conditions are (a) the vertical dimension of the fluid is much less than any scale height, and (b) the motion-induced fluctuations in density and pressure do not exceed, in order of magnitude, the total static variations of these quantities. Under these conditions the equations are formally equivalent to those for an incompressible system when the temperature gradient is replaced by its excess over the adiabatic and C_p replaces C_v.

536.2

6984 FORCED HEAT CONVECTION IN LAMINAR FLOW THROUGH RECTANGULAR DUCTS.

S.C.R.Dennis, A.McD.Mercer and G.Poots.

Quart. appl. Math., Vol. 17, No. 3, 285-97 (Oct., 1959).

The heat transfer to the wall of a duct through which a hot viscous fluid passes is considered. The thermal properties of the fluid are assumed to be independent of temperature, liquids are incompressible and gases are perfect. The rectangular cross-section gives rise to a three-dimensional temperature distribution. Clark and Kays [Transactions of the American Society of Mechanical Engineers, Vol. 75, 859-866 (1953)] obtained results assuming a fully developed temperature profile. In the present paper theoretical results taking into account the undeveloped temperature profile are derived. The governing equations are set up and the method of solution used is similar to that of Galerkin. Relaxation methods in conjunction with Rayleigh's principle are used to obtain the computational results and the constant wall temperature case is treated in some detail. The considerable discrepancy between Clark and Kays experimental linear correlation between the mean logarithmic Nusselt number and the aspect ratio, and the theoretical curve obtained by the authors, is discussed. S.Weintroub

536.2

6985 ALTERNATIVE METHOD OF CORRELATING FORCED CONVECTION HEAT TRANSFER DATA. P.H.Price.

Brit. J. appl. Phys., Vol. 10, No. 3, 135-8 (March, 1959).

The use of a heat transfer coefficient as a general parameter o forced convection heat transfer is shown to be unsatisfactory, and a alternative correlation making explicit allowance for pipe wall temperature variations is derived. In the derivation it is assumed that radial heat transfer in the fluid may be represented as due to an effective conductivity, and that longitudinal heat transfer is by fluid transport only. The effective conductivity and the fluid forwar velocity may be arbitrary functions of radial distance. The correlation shows that the difference between wall and mean fluid temperature at any distance along the tube is composed of an entry condition term which diminishes with distance along the pipe, plus a series of terms due to temperature variations along the pipe wall. The values of the coefficients of these terms have been calculated for two ideal cases, and experimental values are being sought. Som implications of the correlation are discussed.

536.2

6986 AN OPTICAL METHOD OF MEASURING CONVECTIVE AIR VELOCITY. H.N.Patil.

Indian J. Phys., Vol. 31, No. 10, 539-40 (Oct., 1957).

The interferometric method discussed by Kennard (1941) can be used to find the velocity of air rising from a hot source. The theory is outlined. E.A.Musset

536.2

6987 COOLING OF A SPINNING THREAD-LINE. E.H.Andrews.

Brit. J. appl. Phys., Vol. 10, No. 1, 39-43 (Jan., 1959).

The cooling of an extruded stream of molten polymer is considered for the case in which the solidified thread-line is "wound-u some distance from the spinneret. The heat flow equations are set up and solved approximately with the aid of empirical data. The pre dicted temperature-distance relations appear to be substantially correct, though the predicted radial temperature distribution in the thread-line is only accurate to within 20%.

536.2 : 537.

ELECTRIC STRESS AND HEAT TRANSFER. See Abstr. 5256

536.

6988 THE SPECTRAL EMISSION OF RADIATION BY GLASS. J.R.Beattie and E.Coen.

Brit. J. appl. Phys., Vol. 11, No. 4, 151-7 (April, 1960).

The spectral radiation emitted normally from the surface of a thin sheet of glass having a specified temperature distribution throughout its thickness is calculated for the wavelength range 0.1 to 6.0 μ. From the results obtained, the design of a radiation pyrometer capable of measuring both the surface and inside temperatur of the glass is described. The pyrometer consists of two radiation detectors, one with a filter to measure only the radiation arising from, and hence the temperature of, the surface of the glass, the other with a filter to measure the radiation arising from the interio of the glass and which therefore has a response dependent on the temperature distribution within the glass.

536.

6989 GUIDANCE ON THE USE OF PLANCK'S RADIATION FORMULA IN INFRA-RED TECHNOLOGY. R.Schulze

Lichttechnik, Vol. 12, No. 3, 126-30 (March., 1960). In German.

For use in the i.r., Planck's formula is most conveniently expressed as a product of an integrand with λ^{-4} in the numerator and a dimensionless wavelength interval $\Delta\lambda/\lambda$. A convenient meth for deriving the spectral distribution of a full radiator at any temperature T is given. Spectral distribution is best plotted against the log. of the wavelength or the frequency, so that $\Delta\lambda/\lambda$ or $\Delta\nu/\nu$ is constant. It is proposed that the limits of integration should be chosen so that the energy excluded at each end is 2.4% of the total. For $T = 600^\circ$K the maximum of the curve is at 6.1 μ.

J.W.T.Wals

536.

6990 A RADIATION THERMOELEMENT WITH DIRECT VISUAL ADJUSTMENT.

A.M.Brounshtein and L.B.Krasil'shchikov.

Optika i Spektrosk., Vol. 4, No. 3, 412-13 (1958). In Russian.

A thermoelectric cell was developed in which the receiving rface can be observed simultaneously with the source for the rpose of focusing. The thermocell tube is a cylinder, one base of ich is a window transparent to both the radiation being studied and visible radiation; the other base is a plane parallel piece of glass. e vacuum in the cylindrical vessel around the tube is preserved by carbon getter. D.J.Huntley

536.41 : 539.2

THERMAL EXPANSION OF CAESIUM IODIDE BY X-RAY FFRACTION AND THE GRÜNEISEN'S PARAMETERS. See Abstr. 26

536.41 : 539.214

THERMAL EXPANSION OF FLUOROPLAST IV BETWEEN 90 AND 325° C. See Abstr. 6376

536.42

6991 EQUATION OF THE PHASE-TRANSITION CURVE. G.A.Martÿnov.
bkl. Akad. Nauk SSSR, Vol. 129, No. 3, 620-2 (Nov. 21, 1959). Russian.

Since Δv in the process of fusion is a complex function of T and the integration of the Clausius-Clapeyron formula presents diffi- lties. By expanding Δv into series and taking only its first terms, hile Δc_p is assumed to be constant, the author derives a relation r $P = P(T)$. The calculated results obtained for Δv and P in the se of the phase transition ice—water for the pressure range 2045 atm (Δv range 0.090-0.1352 cm^3g^{-1}; $T-T_0$ range 0- −22°C) ere found to differ by ≤ 4% from the experimental values.

F Lachman

536.42 : 533.7

6992 APPLICATION OF THE MAYER METHOD TO THE MELTING PROBLEM. H.N.V.Temperley.
roc. Phys. Soc., Vol. 74, Pt 2, 183-95 (Aug., 1959).

The antiferromagnetic Ising model can also describe a gas with urely repulsive intermolecular forces, and a comparison of the two made, the transition of such a "gas" to a solid-like structure eing the analogue of the appearance of an antiferromagnetic struc- ure. Three simple lemmas enable the asymptotic behaviour of the ayer cluster sums to be related to other combinatorial problems n the lattice, such as that studied by Hammersley and Broadbent 957). Some information on these problems is already available, ut a detailed discussion is reserved to another paper. The Mayer ormalism can be generalized to deal with the antiferromagnetic roblem, with the conclusion that the transition is probably first- rder and associated with a singularity of the Mayer b-series on e positive real axis of the z variable, but that there is a closer ne on the negative real axis. The Mayer β-series can probably be xtended beyond the transition and corresponds to a metastable iquid. Its divergence probably represents the absolute limit of the etastable state. The symmetry of the particular model used mplies a second transition at a still higher density which may be ikened to a change of crystal structure. (The gas of completely igid molecules is a limiting case, and has only one transition, the ransition curve then being a linear relation between P and T). hese considerations agree well with other work on the antiferro- agnetic Ising model. A "solid—gas" critical temperature seems ost unlikely for any realistic interaction, though it could occur or a sufficiently "soft" one.

536.42 : 533.7

6993 CAN THE "LATTICE" MODEL OF A GAS DESCRIBE BOTH LIQUEFACTION AND SOLIDIFICATION?
.N.V.Temperley.
Proc. Phys. Soc., Vol. 74, Pt 4, 444-8 (Oct., 1959).

A preliminary study is made of a two-dimensional model of an mperfect gas of "attracting rigid squares" which is a limiting ase of the two-dimensional Ising model with second-nearest neigh- bour interactions of Domb and Potts (1951). The qualitative behaviour of the high-order Mayer cluster-sums is determined by a method used earlier by the author (see preceding abstract). It is found that t high temperatures these sums alternate in sign, which is what would be expected if the approaching transition were the formation of an ordered structure. As the temperature is lowered, the analytic behaviour of the cluster-sums progressively changes to what was ound by Yang and Lee when the approaching transition involves the ormation of large domains, analogous to liquefaction. It is tenta- ively concluded that this version of the Ising model may show two ransitions below a certain critical temperature, just like a real mperfect gas.

536.42

6994 DETERMINATION OF THE ENTHALPY OF SOLIDIFICATION (FREEZING) OF METALS AND ALLOYS BY DIFFERENTIAL THERMAL ANALYSIS. T.Heumann and B.Predel.
Z. Elektrochem., Vol. 63, No. 8, 988-94 (1959). In German.

The apparatus and its (electrical) calibration are described. Its usefulness is demonstrated by application to the determination of ΔH in the freezing of cadmium and to the determination of the enthalpy of mixing of a gallium—cadmium alloy.

W.Good

536.42

6995 DESIGN PROBLEMS IN EBULLIOMETRY OF POLYMERS. W.R.Blackmore.
Rev. sci. Instrum., Vol. 31, No. 3, 317-21 (March, 1960).

There are two fundamental problems in ebulliometry. The first is to find a detector with sufficient sensitivity to measure the very small boiling point elevations obtained with dilute solutions of high polymers. This problem is solved easily with thermistor bridges and modern high-gain amplifiers. The second problem is that of random thermal fluctuations or background noise in the ebulliometer itself. When this study began, it was considered that there were three probable sources of noise, viz., (1) superheated liquid from the Cottrell pump, (2) pressure fluctuations and differences within the ebulliometer, and (3) the presence of foam which usually appears when a polymer solution is maintained at the boil. However, the tests carried out with the ebulliometers described here seem to indicate that the difficulties may be inherently associated with the polymer solutions themselves.

536.42 : 523.5

6996 CONDENSATION OF A VAPOUR CLOUD EXPANDING INTO VACUUM. Yu.P.Raizer.
Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1741-50 (Dec., 1959). In Russian.

The kinetics of condensation of a vapour cloud expanding into vacuum is considered. It is shown that, for a large variety of initial conditions, the matter at infinity expands partly as a gas and partly in the form of very small particles of the condensate, the number and size of these particles being dependent on the evaporated mass and on its initial temperature. It is suggested that when large meteorites strike the surface of planets without atmosphere the ground of the latter and body of the meteorite may evaporate and subsequently condense and that this process may be one of the sources of cosmic dust. The possibilities of laboratory investigation of condensation of metallic vapours and of the properties of the small particles involved are discussed.

536.42

6997 MEASUREMENT OF THE PRESSURE OF VAPOUR IN EQUILIBRIUM WITH SOLID BERYLLIUM OXIDE.
L.P.Belÿkh and A.N.Nesmeyanov.
Dokl. Akad. Nauk SSSR, Vol. 128, No. 5, 979-80 (Oct. 11, 1959). In Russian.

The vapour pressure of solid specimens (~ 99.5% BeO) was determined by the method of evaporation from the free surface into vacuum and by the integral version of the effusion method, the measurements being carried out in the interval 2103-2573°K. The results were found to be in agreement with those obtained by Erway and Seifert [J. Electrochem. Soc., Vol. 98, 83 (1951)]; they yielded the equation $\log P_{atm} = 8.156 - (3.324/T) \times 10^4$, which, in turn, yields the heat of sublimation $\Delta H_0^0 = 157.6$ kcal/mole. Since the results of the effusion experiments coincided with those carried out by Langmuir's method, the coefficient of condensation of BeO can be assumed to be ~1.

F.Lachman

536.46

6998 THE PERFORMANCE OF SPARK GUARDS. J.H.McGuire and M.Law.
Brit. J. appl. Phys., Vol. 9, No. 12, 470-4 (Dec., 1958).

The probabilities that various sizes of live coal will ignite various domestic materials have been determined. In addition the maximum probability that a coal will pass through a mesh has been calculated. Combining the two results has given a measure of the efficiency of spark guards in reducing fire risk. It is suggested that non-flammable nylon net is a suitable material for a combined fire and spark guard.

536.46

6999 METHODS FOR THE STUDY OF DEFLAGRATION TO DETONATION TRANSITION. A.B.Amster.
Rev. sci. Instrum., Vol. 31, No. 2, 219-20 (Feb., 1960).

The claim of Gibson, Bowser, and Mason (Abstr. 3312 of 1960) that detonation was recorded in a propellant is criticized. The detector responds to the ionized gas produced by a shock wave. If the detector is inserted in a slit in a solid material, the air remaining in the slit may be ionized by a weak shock which is not the result of detonation. It is suggested that a shock must travel a distance equal to twice the diameter of the charge before it is certain that the shock is stable. The detector cannot be used to measure deflagration rates since these are increased by its presence.

E.R.Wooding

536.5 : 621.365.32

7000 SELF-SUPPORTING HEATING ELEMENT.

J.Rothstein.

Rev. sci. Instrum., Vol. 31, No. 3, 306-7 (March, 1960).

A heating element design is described, applicable to graphite or sheet metal, which has an electrical resistance comparable to a helix and a structural rigidity comparable to a cylinder. Incomplete cuts perpendicular to the axis create a number of electrically long paths in parallel, each with relatively short distances between regions of mechanical support.

536.5 : 621.365

7001 DESIGN OF LABORATORY FURNACES.

P.L.Start and M.W.Thring.

J. sci. Instrum., Vol. 37, No. 1, 17-24 (Jan., 1960).

Illustrates the use of a heat balance in the design of small furnaces, and then discusses the principles of arc, arc-image, induction, electron-bombardment, resistor heated and gas-filled furnaces. Constructional details are mentioned briefly with each type of furnace considered. A comprehensive table of resistor elements, refractory tubes, and insulating materials and their properties is included. Methods of controlling small furnaces are discussed in the final section.

536.53

7002 RESISTANCE—TEMPERATURE RELATIONSHIP OF PLATINUM AT LOW TEMPERATURES AND ITS INFLUENCE ON PRECISION THERMOMETRY.

G.C.Lowenthal and A.F.A.Harper.

Brit. J. appl. Phys., Vol. 11, No. 5, 205-8 (May, 1960).

An analysis of the results of measurements of the resistance of platinum as a function of its temperature and purity indicates that known weaknesses in the Callender—Van Dusen equation can be explained by the presence of a point of inflection in the resistance—temperature curve near 86° K, only a few degrees below the present lower limit of the International Temperature Scale (I.T.S.). A satisfactory interpolation formula for temperature measurement below 90° K can be obtained if account is taken of the fact that dR/dT for platinum is the greater the purer the metal only above about 26° K, while the reverse is true below that temperature. This suggests the use of the normal boiling point of neon (27.07° K) as an intermediate fixed point. If this point should prove adequately reproducible, it should prove practicable to extend the I.T.S. by means of the simple so-called Cragoe function from 90 to 27° K, preferably with a break in the range at the triple point of oxygen (54.36° K).

536.53 : 621.317.39

7003 DIRECT READING RESISTANCE THERMOMETER BRIDGE. I.

T.M.Dauphinee and H.Preston-Thomas.

Rev. sci. Instrum., Vol. 31, No. 3, 253-7 (March, 1960).

Describes the basic circuitry required for a high precision direct reading resistance thermometer with dials calibrated in degrees C and any standard platinum resistance thermometer as sensing element. A circuit was developed which, through linear variations of the resistance elements, gives a quadratic law having the form $R = R_0(1 + AT + BT^2)$, where B is negative, as is required for a platinum thermometer. At the same time it allows separate adjustments for slope A and curvature B or B/A of the resistance v. temperature relation of the particular thermometer being used and also for the ice point resistance R_0. The auxiliary circuitry is given for comparing the computing circuit with the thermometer and for maintaining a constant recorder sensitivity of all temperatures; stability requirements for work to 0.001° C over a 700° C range are discussed.

536.53 : 621.317.39

7004 DIRECT READING RESISTANCE THERMOMETER BRIDGE. II.

T.M.Dauphinee, C.G.M.Kirby and H.Preston-Thomas.

Rev. sci. Instrum., Vol. 31, No. 3, 258-63 (March, 1960).

Presents the details of circuitry and construction for a direct reading resistance thermometer which was built utilizing the desi
criteria formulated in Pt I. By using any standard 25.5 Ω platinum
resistance thermometer as a sensing element, the bridge gives su
division of the temperature scale to 0.001° C between −50° and +700° C with an accuracy exclusive of that of the thermometer of about ± 0.001° C. Methods are described that allow for variations
thermometer constants, for autocalibration of the bridge circuit, a
for maintaining constant sensitivity by variation of the thermomet
current. The bridge as described has performed satisfactorily fo
three years and has proved to be a useful and convenient laborator
tool.

536.53 : 621.317

7005 RUGGED FILM RESISTOR THERMOMETER FOR THE MEASUREMENT OF SURFACE TEMPERATURES.

R.E.Thun, G.F.Caudle and E.R.Pasciutti.

Rev. sci. Instrum., Vol. 31, No. 4, 446-9 (April, 1960).

A resistor thermometer element is described consisting of a
nickel or palladium film protected by an SiO or didymium fluoride
coating. The films are vacuum deposited on a glass substrate wit
imbedded Kovar contacts. The element is capable of withstanding
accelerations up to 10^5 g. It is shown that nickel or palladium film
can be obtained with a resistance—temperature coefficient (r.t.c.)
considerably higher than previously reported. When corrected fo
the anomalous skin effect, a resistivity and a r.t.c. approaching th
bulk values were measured on films deposited at a rate of about 200
and annealed for 20 min at 450° C.

536.53 : 621.3

7006 TWO THERMOCOUPLES SUITABLE FOR MEASUREMENT OF TEMPERATURES UP TO 2800° C.

D.A.Davies.

J. sci. Instrum., Vol. 37, No. 1, 15-17 (Jan., 1960).

The thermoelectric characteristics of two high-temperature thermocouples of tungsten/26% rhenium—tungsten and tantalum/26
rhenium—tungsten are described, and a method of determining the
e.m.f. of the couples up to a temperature of 2800° C is given. In th
temperature range 1000-2000° C, the sensitivity of the tungsten/rh
nium—tungsten couple is 16.2 μV/deg C and that of the tantalum/r
nium—tungsten couple is 13.6 μV/deg C. The important feature of th
thermocouples is their suitability for operation at much higher te
peratures than existing couples, combined with a fairly high sensitivity.

536.54 : 539.

CALORIMETRIC MEASUREMENTS ON SOURCES COMPOSE
OF THE NATURALLY-OCCURRING RADIOACTIVE ELEMENTS. See Abstr. 5685

536.54 : 539.

A CALORIMETRIC DETERMINATION OF THE HALF-LIFE OF Ac^{227}. See Abstr. 5686

536.

7007 COMBUSTION CALORIMETRY WITH FLUORINE: CONSTANT PRESSURE FLAME CALORIMETRY.

G.T.Armstrong and R.S.Jessup.

J. Res. Nat. Bur. Stand., Vol. 64A, No. 1, 49-59 (Jan.-Feb., 1960).

Instruments and methods have been developed and are described for the measurement of heats of reaction between fluorine and other gaseous materials. Verification of the amount of reacti
of hydrogenous materials is possible. The estimated accuracy of
measurements is about 0.3 per cent. Lack of certainty of the mag
nitude of corrections to be applied for hydrogen fluoride nonideali
is an important factor. The heat of formation of hydrogen fluoride is found to be −64.4 ± 0.25 kcal/mole on the basis of the reaction of fluorine with ammonia.

536.

7008 CALORIMETER FOR THE MEASUREMENT OF SPECIFIC HEAT OF LAC.

S.Nath Srivastava.

Indian J. Phys., Vol. 41, No. 9, 443-6 (Sept., 1958).

For the measurement of the specific heat of lac and other ba
conducting materials, a rectangular type of copper calorimeter is designed, which eliminates the sources of errors of the calorimet
used by Bhattacharya (1940). Specific heat of Kusum lac has been measured from room temperature to 110° C, at intervals of 5 deg.
The variation of its specific heat with temperature is discussed.

536.

7009 RECORDING CALORIMETER FOR THE MEASUREMENT OF HEATS OF WETTING, MIXING, OR SOLUT

F.A.P.Maggs and P.H.Schwabe.

sci. Instrum., Vol. 37, No. 2, 60-4 (Feb., 1960).
A calorimeter has been designed for the measurement of heat
erations of less than 50 cal. Automatic temperature recording
n variable amplification has been linked to the measuring thermo-
ples to produce a permanent record of temperature changes in
calorimeter. Magnetically operated stirring and reaction
iation (by bursting an evacuated bulb containing adsorbent or
agent) are employed. Electrical calibration is made for each
tem before and after bursting the bulb. The use of the calori-
er in measuring the heat of wetting of charcoal and the heat
mixing of water and methanol is demonstrated. Application of the
orimeter to other thermometric procedures within the mechan-
l limitations of the instrument is discussed.

536.65 : 539.2 : 548

7010 AN X-RAY STUDY OF THE FACTORS CAUSING VARIATION IN THE HEATS OF SOLUTION OF MAG-
SIUM OXIDE. D.K.Thomas and T.W.Baker.
oc. Phys. Soc., Vol. 74, Pt 6, 673-9 (Dec., 1959).
Line breadths in the X-ray diffraction patterns of a series of
gnesium oxide specimens,prepared by dehydrating brucite at
erent temperatures, were determined using a Geiger-counter
ractometer. Analysis showed that the broadening was primarily
to small crystallite size and permitted correlation of the differ-
heats of solution of various preparations of magnesium oxide
h their mean crystallite sizes.

THERMODYNAMICS

536.7

7011 DISCUSSION OF THE TIMEWISE PROGRESS OF THERMODYNAMIC PROCESSES. G.Fáy and G.Tábori.
ta phys. Hungar., Vol. 10, No. 2, 129-33 (1959). In German.
With certain initial conditions, the generalised forces constrai-
g the approach of a system to equilibrium, will change sign. A
rresponding condition on the response matrices is deduced.

P.Gray

536.7

7012 CHAPTERS ON THE MECHANICAL THEORY OF HEAT. I.Erdélyi.
ta tech. Hungar., Vol. 27, No. 1-2, 127-45 (1959).
Some thermodynamic phenomena are explained with the methods
mechanics: 1) The flow energy of a gas passing through a nozzle
limited to one third the total kinetic energy, and the pressure in
e nozzle region is non-isotropic. 2) A temperature gradient exists
a gas in a mechanical field, directed towards the centre of the
eld. 3) The gradient calculated to exist along the radius of a tube
ntaining a rapidly rotating gas agrees with experiment.

P.Gray

536.7

7013 A THERMODYNAMIC DEDUCTION OF THE DYNAMIC SUSCEPTIBILITY. G.V.Skrotskii and V.T.Shmatov.
z. Metallov i Metallovedenie, Vol. 6, No. 2, 358-9 (1958).
Russian.
The thermodynamic system is divided into two parts, that part
ose degrees of freedom are responsible for the effect being studied,
d the remainder. The author considers the entropy of both parts,
kes linear approximations to the equations which describe small
partures from equilibrium, and derives an expression for the
usceptibility' as a function of frequency.

M.G.Priestley

536.7

7014 TEMPERATURE FLUCTUATIONS IN THERMO-DYNAMIC EQUILIBRIUM. R.M.Mazo.
ysica, Vol. 25, No. 1, 57-9 (Jan., 1959).
Temperature fluctuations in a system at equilibrium are calcu-
ted in such a way as to remove objections that consideration of
ch fluctuations is physically meaningless.

536.7

7015 SUBLIMATION AND THE THIRD LAW OF THERMODYNAMICS. S.J.Glass and M.J.Klein.
hysica, Vol. 25, No. 4, 277-80 (April, 1959).
Discusses the question: does the existence of non-zero heats of sublimation at absolute zero constitute a violation of the third law of thermodynamics? It is shown that there is no violation, even though the vapour must behave like a "classical" ideal gas and have an entropy per particle proportional to the reciprocal temperature, because the number of particles in the vapour phase vanishes exponentially as absolute zero is approached.

536.7

7016 GENERALIZED THEORY OF THERMAL TRANSPIRATION AND THERMAL DIFFUSION BASED ON THE THERMODYNAMICS OF IRREVERSIBLE PROCESSES.
R.P.Rastogi and R.C.Srivastava.
Physica, Vol. 25, No. 5, 391-7 (May, 1959).

A theory is developed for a mixture involving a single chemical reaction. It is valid even when a non-linear relation between chemical reaction rate and affinity exists but the domain of validity of the theory cannot exceed the range of validity of the Gibbs formula for entropy production. A qualitative estimate of the difference in the values of thermal diffusion factors with and without chemical reaction for ortho- and para-hydrogen mixture is made. It appears that at low temperature the difference is negligible but at higher temperature it may become significant.

536.7 : 530.16

IRREVERSIBLE THERMODYNAMICS AND CONTINUUM MECHANICS. See Abstr. 6689

536.7 : 537.2

IRREVERSIBLE THERMODYNAMICS OF THE VOLTA-EFFECT See Abstr. 5249

536.7 : 530.16

THE ENTROPY OF A NON-EQUILIBRIUM IDEAL QUANTUM GAS. See Abstr. 6703

LOW-TEMPERATURE PHYSICS

536.48

7017 PROCEEDINGS OF KAMERLINGH ONNES CONFERENCE ON LOW TEMPERATURE PHYSICS.
Physica, Vol. 24, Supplement, S1-S188 (Sept., 1958).

175 papers presented at an international conference held at Leyden 23-28 June, 1958. Of these 24 were united papers on subjects of general interest. The bulk of the remainder are presented as short summaries only. Abstracts will be found under the appropriate headings in this or succeeding issues of "Physics Abstracts".

536.48

7018 CONDENSATION OF SUPERSATURATED He^4 VAPOR IN A CLOUD CHAMBER.
M.H.Edwards and W.C.Woodbury.
Canad. J. Phys., Vol. 38, No. 3, 335-45 (March, 1960).

The critical supercooling, ΔT_C, required to produce visible condensation in pressure-limited adiabatic expansions of presumably ion-free saturated He^4 vapour has been measured in a small glass cloud chamber. The transient gas temperatures were measured during expansions by using a carbon resistance thermometer in a Wheatstone bridge. An oscilloscope was used in place of a galvanometer, and its trace was photographed during expansions. Low-amplitude temperature oscillations in the gas, which might not normally have been detected, were frequently observed in the early stages of this work. These oscillations with appeared spontaneously ("Taconis Resonances"), or could be shock-excited by an expansion. These oscillations were subsequently eliminated. Condensation thresholds were then measured using starting temperatures from 4.2 to 1.7°K. ΔT_C dropped from about 50 to 60 mdeg above the λ point to less than 20 mdeg below the λ point. The critical supersaturations required to produce condensation were thus always less than 105%. The supersaturations were calculated without making the usual but highly implausible, assumption that the expanding gas is ideal. Assuming that the condensation nuclei are embryonic droplets arising accidentally from density fluctuations in the supersaturated vapour, the critical droplet radius is found to be about 10^{-6} cm above 2.5°K, although the theoretical treatment here is not rigorous.

536.48

7019 ON THE THICKNESS OF HELIUM FILMS.
B.K.Agarwal.

Proc. Phys. Soc., Vol. 74, Pt 2, 217-18 (Aug., 1959).

Empirical expressions are suggested to describe the observed height–thickness curves for liquid helium films of from 1 to 5 cm height; these have a basically exponential form. L.Mackinnon

536.48

7020 SUPERFLUIDITY OF LIQUID He^3.
L.P.Pitaevskii.

Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1794-807 (Dec., 1959). In Russian.

A strict investigation is made of the interaction between fundamental excitations in a Fermi fluid for large values of angular momentum relative to the excitation motion. It is shown that this interaction has the nature of an attractive force so that the suggestion that He^3 is superfluid seems to be justified. Expressions in terms of observable quantities are derived for the asymptotic values of the excitation scattering amplitudes for large values of l. A formula is deduced for the effective mass of an excitation in a Fermi fluid by quantum field theory methods.

536.48

7021 A STUDY OF THE TEMPERATURE DEPENDENCE OF THE ELEMENTARY EXCITATIONS IN HELIUM II BY THE USE OF COLD NEUTRONS. K.E.Larsson and K.Otnes.

Ark. Fys., Vol. 15, Paper 4, 49-63 (1959).

Independently of the Los Alamos work (Abstr. 6924 of 1958) the variation with temperature of the dispersion curve of the elementary excitations in He II has been studied in the temperature region $1.44 \leq T \leq 2.37^\circ K$ by observing the angular and energy distribution of cold, beryllium-filtered neutrons scattered from liquid He. The observed temperature dependence of the minimum excitation energy Δ in the roton region is very well fitted by the functions

$$\Delta/k = 8.5[1 - 7.5\sqrt{T}\ \exp(-8.5/T)]^0 K \text{ for } 1.4 \leq T \leq 1.9^0 K,$$
$$\Delta/k = 8.5[1 - 1050(\sqrt{T}\ \exp(-8.5/T))^{13/6}] \text{ for } 1.8 \leq T \leq 2.15^0 K.$$

The experimentally observed width δE of the roton line is well described by

$$\delta E/k = 302\ \sqrt{T} \exp(-8.5/T) \text{ for } T < 2^0 \text{ and}$$
$$\delta E/k = 2060\ (\sqrt{T} \exp(-8.5/T))^{3/2} \text{ for } T \geq 2^0.$$

H.London

536.48

7022 NUCLEAR SPIN RELAXATION IN LIQUID He^3. II.
R.H.Romer.

Phys. Rev., Vol. 117, No. 5, 1183-7 (March 1, 1960).

For Pt I, see Abstr. 1068 (1960). The nuclear spin thermal relaxation time, T_1, of He^3 nuclei in pure liquid He^3 at its saturated vapour pressure was measured at temperatures between 0.8° and $3.1^\circ K$, at static magnetic fields from 1560 to 12 200 G. No dependence of T_1 on the static magnetic field was observed. The measured relaxation times increase gradually from 300 sec at $0.8^\circ K$ to 650 sec at $3.1^\circ K$. These measured relaxation times do not appear to have been significantly shortened by wall relaxation processes. The results, which do not agree with measurements made elsewhere, are in good agreement with the short correlation time form of the Bloembergen, Purcell, Pound theory of spin relaxation in liquids. (Abstr. 2529 of 1948).

536.48

7023 EVIDENCE FOR THE QUANTIZATION OF CIRCULATION IN LIQUID HELIUM II. C.E.Chase.

Phys. Rev. Letters, Vol. 4, No. 5, 220-1 (March 1, 1960).

Critical heat currents were measured in a tube 5 cm long, packed with fine wires to form parallel channels about 0.02 cm wide. When the tube is rotated about an axis perpendicular to itself at angular frequency ω, the critical current falls sharply at $\omega^{1/2} \cong 0.6$, 1.3, 1.9 $sec^{-1/2}$, suggesting the appearance of successive sets of quantized vortex lines at these values of ω. R.G.Chambers

536.48

7024 DAMPING OF DISK OSCILLATIONS IN ROTATING HELIUM II. Yu.G.Mamaladze and S.G.Matinyan.

Zh. eksper. teor. Fiz., Vol. 38, No. 1, 184-7 (Jan., 1960). In Russian.

Interaction of an oscillating disk with rotating helium II is examined. An expression is obtained for the torsional moment acti on the disk surface, taking into account the presence of vortex lines mutual friction between the normal and superfluid components and the possibility of sliding of the vortex lines along the solid surface. Computation of the oscillation damping, neglecting sliding and in linear approximation with respect to the mutual friction coefficients agrees qualitatively with experimental data. Quantitative agreemen can be obtained only if sliding is taken into account.

536.4

7025 STRONG-COUPLING LIMIT IN THE THEORY OF SUPERCONDUCTIVITY. D.J.Thouless.

Phys. Rev., Vol. 117, No. 5, 1256-60 (March 1, 1960).

The Hamiltonian used by Bardeen, Cooper, and Schrieffer in the theory of superconductivity (Abstr. 1708 of 1958) is studied in the strong-coupling limit. The complete set of energy levels can be found by using group theory, even for a finite system. An expressi for the grand partition function can immediately be written down, an this expression can be evaluated in a simple manner for a large system. The results are in qualitative agreement with the weak-coupling theory, and in quantitative agreement with the strong-coupling limit of the expressions derived by Bardeen, Cooper, and Schrieffer. The second-order phase transition is a simple consequence of the form of the grand partition function. There is an energy gap independent of the total number of particles which goes to zero as the temperature approaches the critical temperature. T normal state is not metastable below the critical temperature.

536.48

7026 INVESTIGATION OF THE THERMAL PROPERTIES OF SUPERCONDUCTORS. III. ANISOTROPY OF THE THERMAL CONDUCTIVITY OF GALLIUM. N.V.Zavaritskii.

Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1506-16 (Dec., 1959). In Russian.

For Pt II, see Abstr. 1360 (1959). The thermal conductivity of gallium in the normal and superconducting states has been measure along different crystallographic directions. The anisotropy detecte in the temperature dependence of the electron thermal conductivity in the superconducting state is related to the anisotropy in the gap width in the excitation energy spectrum. Results of measurement c the critical magnetic field are presented.

536.4

7027 TRAPPED FLUX IN SUPERCONDUCTING MIXED-CRYSTALS. A.Calverley and A.C.Rose-Innes.

Proc. Roy. Soc. A, Vol. 255, 267-76 (April 5, 1960).

Residual trapped magnetic flux, arising from incomplete Meissner effect, has been studied experimentally in a number of single tantalum–niobium mixed-crystals. In these crystals the periodicity of the lattice potential is partially destroyed by the random occupation of the lattice sites by the two kinds of atom. As a result the conduction electrons in the normal state have a short mean free path and the crystals exhibit to a marked degree the properties of a 'non-ideal' superconductor, such as wide transitions and high critic magnetic fields. It is found, however, that if the crystals are pure there is no detectable trapped flux. This is interpreted as showing that, if flux is to be trapped, there must be sites present which act as barriers to the movement of normal regions, preventing their escape to the surface.

536.4

7028 THE INTERPHASE SURFACE ENERGY IN SOME PURE AND IMPURE SUPERCONDUCTORS. E.A.Davies.

Proc. Roy. Soc. A, Vol. 255, 407-26 (April 16, 1960).

A new method has been developed for obtaining relative values of the surface energy parameter, Δ, in superconductors. It involv the measurement of the resistance of thin films subjected to a tran verse magnetic field. The method has been applied to tin, indium a aluminium and to dilute alloys of the first two. The principal new r sults are that Δ is 1.48 times larger in indium than in tin and that the addition of impurity to either metal lowers Δ without changing the nature of its temperature dependence. These conclusions are compared with current theories of the interphase surface energy. An attempt has been made to deduce the absolute magnitude of Δ, which requires a detailed analysis of the way in which the last trac of the superconducting phase are eliminated from the film by the action of the magnetic field. The analysis is necessarily over-sim lified but it does give a figure for Δ in pure tin which is reasonabl consistent with the previous estimates of Faber and Sharvin.

536.48 : 538.1 : 621.318.3

7029 SUPERCONDUCTING ELECTROMAGNETS.
S.H.Autler.

ev. sci. Instrum., Vol. 31, No. 4, 369-73 (April, 1960).

Experiments or devices requiring the joint use of liquid helium nd magnetic fields can make use of superconducting electromagnets. olenoids capable of producing up to 4300 G in large volumes are escribed. Higher fields, up to 14 kG, have been produced by ironbre superconducting magnets. A small power supply may be used energize one of these magnets and then disconnected after a peristent current has been set up. A stable magnetic field is thus aintained for many hours if the magnet is kept cold.

536.48 : 538.1

SUSCEPTIBILITY OF SUPERCONDUCTING SPHERES. See bstr. 5375

536.48 : 539.2 : 538.2

7030 POSSIBLE EXPLANATION OF THE "COEXISTENCE" OF FERROMAGNETISM AND SUPERCONDUCTIVITY.
B.T.Matthias and H.Suhl.

Phys. Rev. Letters, Vol. 4, No. 2, 51-2 (Jan. 15, 1960).

It is suggested that in rare earth alloys which appear to show erromagnetic and superconducting behaviour simultaneously, the superconducting regions may form a sponge structure located in he ferromagnetic domain walls. R.G.Chambers

536.48

7031 THE INTERMEDIATE STATE IN FERROMAGNETIC SUPERCONDUCTORS. G.F.Zharkov.

Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1784-8 (Dec., 1959). In Russian.

A range of external magnetic field values was found for which he single-domain ferromagnetic ellipsoid may exist in the internediate state. The structure of the intermediate state was studied vithin the framework of the unbranched model for a superconducting erromagnetic plate.

536.48

7032 SUPERCONDUCTIVITY OF DILUTE INDIUM—MERCURY ALLOYS. M.D.Reeber.

Phys. Rev., Vol. 117, No. 6, 1476-82 (March 15, 1960).

Measurements were made of the critical magnetic field for the ransition from the superconducting to the normal state in polyrystalline rods of the substitutional solid solution In—Hg, containing 0-7 atomic percent Hg. The treatment given these alloys was designed to assure homogeneity in composition in which case the transitions to the normal state were found to be similar to those for pure elemental superconductors. It was, moreover, possible to distinguish between properties that are characteristic of the ideal alloy system and properties which arise from structure within the specimen. T_c, the transition temperature at zero field, was measured as a function of composition and was found initially to decrease (up to a concentration of 1.75 atomic percent Hg) after which it began to increase with added Hg concentration. The width of the transition to the normal state, as measured by the variation of specimen resistance in a longitudinal magnetic field, was found to show a regular dependence upon composition, and also reached a minimum value at 1.75 atomic percent Hg. The superconducting properties of pure indium were measured and used as a standard. For indium it was found that: $T_c = 3.407 \pm 0.002°$ K; $H_0 = 293 \pm 2\%$ Oe; and $(dH_c/dT)\ T_c = -155.5 \pm 3\%$ Oe/°K.

536.48

7033 THE THERMAL RESISTANCE OF TIN—INDIUM ALLOYS IN THE INTERMEDIATE STATE.
K.Mendelssohn and C.A.Shiffman.

Proc. Roy. Soc. A, Vol. 255, 199-213 (April 5, 1960).

The thermal conductivity and magnetic moment of several Sn-In alloys were measured during the destruction of superconductivity by a transverse magnetic field. The alloys contained from 2 to 8% In and were examined in the range from about 2° K to the transition temperature T_c. The samples with less than 4 or 5% In show the maxima in the intermediate state thermal resistivity which have been observed by many authors in the case of pure metals. The temperature dependence of the "additional resistivity", w_a, deduced from the maxima varies with impurity and does not agree in any case with the results on pure metals. A simple extension of existing theory shows, however, that the discrepancy is due to a large contribution to w_a by phonon scattering at laminar boundaries. The laminar period, z, is deduced and is shown to decrease with increasing impurity concentration. For indium concentrations larger than 4 or 5% the maxima vanish. This is shown to occur when the electronic mean free path $l_{en} \sim \lambda$, the penetration depth, where the magnetic momenta data indicate that large superconducting regions can be stable in fields greater than H_c. The disappearance of w_a is attributed to $z \ll l_{gs}$, the phonon mean free path, and $z \sim l_{en}$ under these conditions.

536.48

7034 OBSERVATION OF THE ENERGY GAP BY LOW-TEMPERATURE PENETRATION DEPTH MEASUREMENTS IN LEAD. M.P.Sarachik, R.L.Garwin and E.Erlbach.

Phys. Rev. Letters, Vol. 4, No. 2, 52-5 (Jan. 15, 1960).

The penetration depth is determined from the mutual inductance between two coils screened from each other by a cylindrical film of evaporated lead, 150-400 A thick. The detailed interpretation suggests that the correlation length is probably small compared with the penetration depth, and that the energy gap is about $4.9\,kT_c$. R.G.Chambers

536.48 : 518.5 : 621.374.32

7035 RELAXATION TIMES IN LEAD FILM, SUPERCONDUCTIVE, STORAGE ELEMENTS.
R.F.Broom and O.Simpson.

Brit. J. appl. Phys., Vol. 11, No. 2, 78-80 (Feb., 1960).

An experiment is described which measures the critical current of a lead-film Crowe cell during the first microsecond after switching. The minimum writing time of such storage cells should be equal to the time required for the critical current to recover to one half of its initial value. Good correlation is found between the recovery times and the writing times for Crowe cells deposited on various substrates. Cells deposited on mica or sapphire recovered in 50 mμs, while those on glass required approximately three times as long. Measurements were also made of the critical current as a function of temperature, and these are used to derive cooling curves during the recovery phase. The cooling curves are not related to the thermal conductivities of the substrates in any simple way, probably because the rate of cooling is determined primarily by the thermal resistance between film and substrate.

536.48

7036 THE "1958 He^4 SCALE OF TEMPERATURES". I. INTRODUCTION. II. TABLES FOR THE 1958 TEMPERATURE SCALE.
F.G.Brickwedde, H.van Dijk, M.Durieux, J.R.Clement and J.K.Logan.

J. Res. Nat. Bur. Stand., Vol. 64A, No. 1, 1-17 (Jan.-Feb., 1960).

The generally used practical scale of temperatures between 1° and 5.2° is the He^4 vapour pressure scale based on an accepted vapour pressure equation or table. In 1958, the International Committee on Weights and Measures recommended for international use the "1958 He^4 Scale" based on a vapour pressure table arrived at through international cooperation and agreement. This table resulted from a consideration of all reliable He^4 vapour pressure data obtained using gas thermometers, and paramagnetic susceptibility and carbon resistor thermometers. The theoretical vapour pressure equation from statistical thermodynamics was used with thermodynamic data on liquid He^4 and the vapour equation of state to insure satisfactory agreement of the vapour pressure table with reliable thermodynamic data.

536.48

7037 GENERATION OF TEMPERATURES BELOW 1° K.
D.F.Brewer.

Nature (London), Vol. 185, 349-50 (Feb. 6, 1960).

Report of a Physical Society symposium held in December 1959. The papers presented included the following topics: (1) liquid He^3 and liquid He^4 as constant temperature baths; (2) production of low temperatures by (a) adiabatic demagnetization of paramagnetic salts, (b) nuclear adiabatic demagnetization and (c) reversible adiabatic dilution of liquid He^3 with liquid He^4; (3) recent experiments on liquid He^3.

536.48

7038 SOME EXPERIMENTS ON HEAT TRANSFER BELOW 1° K.
A.R.Miedema, H.Postma, N.J.van der Vlugt and M.J.Steenland.

Physica, Vol. 25, No. 6, 509-20 (June, 1959).

A method for attaining thermal contact at very low temperatures is described in which use is made of solutions of paramagnetic salts in alcohol. Single crystals of CrK-alum and CeMg-nitrate were indirectly cooled by this method. In the case of the latter crystals a temperature of 0.015° K has been reached. The heat flow at this temperature differs only slightly from the maximum possible value, evaluated from Debye's theory.

536.48

7039 TEMPERATURE STRATIFICATION IN A NONVENTING LIQUID HELIUM DEWAR.

L.E.Scott, R.F.Robbins, D.B.Mann and B.W.Birmingham.

J. Res. Nat. Bur. Stand., Vol. 64C, No. 1, 19-23 (Jan.-March, 1960).

The presence of a large temperature gradient in Dewars used for transporting helium is undesirable because it may be accompanied by unnecessarily high internal pressures when the contents are sealed. In a study of the problems, such gradients were observed in experiments conducted with a 39.7 l. stainless steel Dewar. A method is shown for calculating the pressure rise in the absence of temperature gradients and the results are compared with the observed pressure rise. In some cases curves representing calculated and observed pressure rise intersect. A possible explanation of this situation is given. The destratifying effect of a concentrated heat input and of copper rods is shown.

536.48

7040 DEWAR SYSTEM FOR LOW TEMPERATURE EXPERIMENTS. C.T.Zahn.

Rev. sci. Instrum., Vol. 31, No. 3, 328-30 (March, 1960).

A special system of glass Dewars for experiments at low temperatures is described in which the liquid nitrogen shield consists of two separate parts, one dipping into the other. The upper shield is constructed with three walls rather than the usual two, since it must be open at the bottom. The liquid helium Dewar fits fairly closely inside this extra wall, with a thin air space between the two, and extends downward into the lower shield. The upper shield thus is mechanically isolated from the liquid helium Dewar. Access to a cold spot of the liquid helium flask is provided by a tube passing upward through the bottom of the lower shield and coupled to the liquid helium flask by means of a spherical ground-glass joint. Various advantages of this system and possible modifications thereof are discussed.

536.48

7041 EXPANSION ENGINES FOR HYDROGEN LIQUEFIERS. E.H.Brown.

J. Res. Nat. Bur. Stand., Vol. 64C, No. 1, 25-36 (Jan.-March, 1960).

Criteria are developed for the practicability of expansion engines and expansion turbines in large hydrogen liquefiers. Some additional data on pertinent properties such as the sonic velocity of normal hydrogen are included. The analysis suggests that use of expansion turbines in hydrogen liquefiers having a production capacity of less than 5000 l./hr ordinarily would not be justified. For greater capacities, however, use of modern materials and design should make expansion turbine performance even more favourable than in liquefiers for denser fluids.

536.48 : 669

METALLURGY AT LOW TEMPERATURES. See Abstr. 6532

ELECTRICITY
ELECTRICAL MEASUREMENTS

537.7

7042 THE MEASUREMENT OF THE POTENTIAL DISTRIBUTION ALONG A SOLID BODY BY MEANS OF AN ELECTRON BEAM PROBE. C.Kleint and K.Kreher.

Exper. Tech. der Phys., Vol. 7, No. 6, 271-7 (1959). In German.

An apparatus is described for measuring simultaneously the potential distribution along a crystal and the current flow. The potential distribution is obtained from the deflections of an electron beam passing close to the crystal surface. A field strength of 20 V/cm caused a deflection of 1 mm. J.Franks

537.7

7043 GRAPHICAL METHOD FOR COMPARING GALVANOMETER SENSITIVITIES. J.W.Dewdney.

Amer. J. Phys., Vol. 28, No. 5, 450-2 (May, 1960).

A method is described for making graphical comparisons of galvanometers of different resistances and periods. The effective sensitivities in a given circuit can also be easily compared.

537.7

7044 AN INDUCTION METHOD OF MEASURING THE HALL EFFECT IN STRONG PULSED MAGNETIC FIELDS.

I.G.Fakidov and É.A.Zavadskii.

Fiz. Metallov i Metallovedenie, Vol. 7, No. 4, 637-8 (1959).

In Russian.

A development of the method of Busch et al. [Helv. Phys. Acta, Vol. 26, No. 3-4, 392-5 (1953)]. A semiconducting specimen is prepared in the form of a thin (~ 1 mm) disk about 10 cm in diameter. A pulsed field of up to 120 kG, normal to the plane of the disk, provides both a magnetic field and the induced currents. The Hall field is measured between the centre and the circumference of the disk. Alternatively, a periodic magnetic field may be used. For metals, a much thinner disk and a l.f. magnetic field are required. A.F.Brown

537.

7045 ON THE INFLUENCE OF SHAPE AND VARIATIONS IN CONDUCTIVITY OF THE SAMPLE ON FOUR-POINT MEASUREMENTS. E.B.Hansen.

Appl. sci. Res. B, Vol. 8, No. 2, 93-104 (1960).

The influence is investigated of the finite size of the sample and of variations in conductivity through the sample on the voltage-current ratio found by four-point measurements. Expressions for this ratio are found for samples of infinite length and with rectangular or semi-circular cross-section. In the first case the influence of a finite length and of an exponential variation of the conductivity along the axis of the sample is examined. A chart showing the correction factor for a bar of rectangular cross-section is presented.

537.7 : 537.3 : 539.

SENSITIVE METHOD FOR MEASUREMENT OF MAGNETORESISTANCE EFFECT WITH DIRECT CURRENTS AND WITH MICROWAVES. See Abstr. 6069

537.7 : 621.317.6

7046 TEST SET FOR DISPLAYING THE VOLT—AMPERE CHARACTERISTICS OF TUNNEL DIODES.

A.M.Goodman.

Rev. sci. Instrum., Vol. 31, No. 3, 286-8 (March, 1960).

A test set is described which permits the display of the V—I (volt—ampere) characteristic of a tunnel diode on an oscilloscope. The circuit instabilities which usually exist when a negative resistance device is tested on a V—I curve tracer are suppressed in the unit described. The principles of design, construction, and operatio are presented.

537.7 : 621.317.3

7047 MEASUREMENT OF THE RESISTIVITY CONSTANTS OF ANISOTROPIC CONDUCTORS BY MEANS OF PLANE-PARALLEL DISCS OF ARBITRARY SHAPE.

J.Hornstra and L.J. van der Pauw.

J. Electronics and Control, Vol. 7, No. 2, 169-71 (Aug., 1959).

It has been shown previously [Abstr. 1039 of 1958) that the resis vity of an isotropic conductor can be determined from measurements o the resistances between four small contacts at arbitrary positions alon the circumference of a plane-parallel sample of arbitrary shape. I is now shown that the expression previously given for isotropic conductors is also applicable to anisotropic conductors if the resistivi constant ρ in that expression is interpreted as the geometric mean of ρ_2 and ρ_3, i.e. $\rho = \sqrt{(\rho_2 \rho_3)}$, where ρ_1, ρ_2 and ρ_3 are the resistivity constants along the three orthogonal axes. Similarly, by using samples with the axes in the appropriate directions, the quantities $\sqrt{(\rho_3 \rho_1)}$ and $\sqrt{(\rho_1 \rho_2)}$ can be determined. C.F.Pizze

537.7 : 621.318.42

7048 CORRECTION FOR SIZE OF CROSS-SECTION OF THE SECONDARY WINDINGS OF MUTUAL INDUCTANCE STANDARDS OF THE CAMPBELL TYPE. P.Vigoureux.

Brit. J. appl. Phys., Vol. 10, No. 11, 481-3 (Nov., 1959).

It is shown that the mutual inductance of standards of the Campbell type can be obtained with negligible error by replacing ea turn of the secondary winding by a circle at the centre of the cross-section of the wire. The total inductance is the sum of the inductances of individual circles; this sum is expressed by a formula whic is shown to agree with Searle's formula provided the length and breadth of winding used in the latter are based on the mean spacing and the mean number of wires in the rows and layers.

537.7 : 621.374.32

7049 DEMONSTRATION LCR CIRCUITS.

T.A.Wiggins and P.W.Jackson.

er. J. Phys., Vol. 27, No. 5, 364-5 (May, 1959).

Describes suitable circuits for use with a square-wave generator llustrate circuit characteristics.

E.G.Knowles

537.7 : 621.376.23

7050 A CONDENSER MEMORY UNIT FOR IMPROVING SIGNAL-TO-NOISE RATIOS.

D.M.Hunten.

nad. J. Phys., Vol. 38, No. 3, 346-53 (March, 1960).

The unit contains 30 low-leakage capacitors which can store a nal for several hours if necessary. If the signal is repeated over over, the successive scans can be added in and the signal-to- se ratio builds up as the square root of the number of repetitions. principle, the final signal-to-noise ratio is only slightly better n would be obtained from a single scan stretched out to fill the me total time, but in practice the result may be considerably ter, especially if the signal fluctuates slowly. It has been used ccessfully in several investigations of twilight spectra with toelectric and photoconductive spectrometers. The original rsion took 1 minute per scan and was rather bulky; a recent dification can scan 32 channels in 10 seconds if required.

537.7 : 621.374.32

7051 EVALUATION OF APPROXIMATE METHODS OF APPLYING BINARY SCALE FACTORS IN PULSE-UNTING SYSTEMS OF MEASUREMENT.

T.Bane and M.P.Atkinson.

t. J. appl. Phys., Vol. 10, No. 3, 124-31 (March, 1959).

An approximate system, which forms the basis of a series of eloped systems, is described. The errors involved are discussed. e effects producing the errors are not arithmetic, and complete oofs are lacking for some of the expressions, which, however, have n checked over the first part of their range.

537.7 : 621.375.232.3

7052 TRANSIENT ANALYSIS OF THE WHITE CATHODE FOLLOWER.

M.Brown.

v. sci. Instrum., Vol. 31, No. 4, 403-9 (April, 1960).

The White cathode-follower is a two-tube series device that ovides output impedances of the order of 5 ohms and transmits ses of either polarity with minimal distortion. A d.c. and tran- ent analysis of the White cathode-follower is made, and a typical cuit is analysed. The effect on the transient response of varying e circuit parameters is discussed. The White cathode-follower is mpared to the well-known conventional circuit. The White circuit y have an advantage in gain—bandwidth over the conventional one a factor of five.

ELECTROSTATICS . DIELECTRICS

(The study of solids through their dielectric properties is included under Solid-State Physics; similarly for Liquid State and Gaseous State)

537.2

7053 THEOREM CONCERNING ANISOTROPIC DIELECTRICS.

G.Power.

it. J. appl. Phys., Vol. 10, No. 1, 32-4 (Jan., 1959).

The perturbation effects of an anisotropic dielectric cylinder t in a general two-dimensional electric field are formulated. The esults are extended to allow for certain other finite conducting or sulated boundaries, thus providing simple solutions for some pparently difficult problems.

537.2

7054 ON PROBLEMS ASSOCIATED WITH TWO-DIMENSIONAL FIELDS IN HOMOGENEOUS ANISOTROPIC MEDIA.

Power and H.L.W.Jackson.

ta Phys. Austriaca, Vol. 13, No. 1, 129-39 (1960).

Solutions are given in terms of complex potential functions hich enable the perturbation effects of a homogeneous anisotropic electric cylinder set in a general two-dimensional electric field be written down. Formulae are developed for the mechanical tion on the portion of anisotropic material inside a given boundary here an electric (or magnetic) field is present. The results are extended to determine the action on the surface of discontinuity between two homogeneous media, and applications are given when one medium is anisotropic and the other isotropic.

537.2

7055 DIELECTRIC DEVICES.

G.T.Wright.

Nature (London), Vol. 185, 360-1 (Feb. 6, 1960).

Report of a conference held at Birmingham in September 1959. Among the topics covered were: masers and parametric amplifiers, physical mechanisms of photoconductivity and luminescence, followed by their use in power amplification; space-charge limited current in dielectric crystals; ferroelectricity.

537.2

7056 CONTACT ELECTRIFICATION AND POLARIZATION OF NYLON THREADS.

R.G.C.Arridge.

Brit. J. appl. Phys., Vol. 11, No. 5, 202-5 (May, 1960).

A study has been made at different relative humidities of the way in which electric charges on nylon threads decay. For relative humidities of less than about 35%, the charges remain localized and decay in magnitude at very nearly an exponential rate. For relative humidities greater than 35% the charges spread out along the thread and the decay of peak charge with time can be approximately represented by a $t^{-1/2}$ law rather than by an exponential one. If a diffusion equation of the type $\rho = At^{-1/2}\exp(-\chi^2/4Dt)$ is applied to the latter results, values of the diffusion constant D are obtained which are independent, within the accuracy of the experiment, of (i) the sign of charge and (ii) whether it was a contact charge or a polarization charge. D varies exponentially with relative humidity.

CURRENT ELECTRICITY

ELECTROKINETICS

(The study of solids through their electrical conduction properties is included under Solid-State Physics)

537.3

7057 EXTREMUM METHODS FOR CERTAIN ELECTRICAL PROBLEMS INVOLVING HOMOGENEOUS ANISOTROPIC MATERIAL.

G.Power.

Appl. sci. Res. B, Vol. 8, No. 2, 84-92 (1960).

Methods are suggested for quickly estimating the value of an important unknown occurring in certain types of electrical problems which involve homogeneous anisotropic material, by bracketing it between upper and lower bounds. These bounds can be obtained by using arbitrarily-chosen admissible functions, or they can be made to depend, in an elementary manner, on the geometry of the system concerned.

537.3

7058 THE VALIDITY OF THE CONCEPT OF SPECIFIC SURFACE RESISTANCE AND ITS MEASUREMENT.

R.Lacoste and P.Paillère.

C.R. Acad. Sci. (Paris), Vol. 250, No. 5, 816-18 (Feb. 1, 1960). In French.

The concept, as applied to solid insulating materials, is restated and then its theoretical justification is demonstrated. It is also shown how the optimal electrode configuration for obtaining accurate measurements can be worked out.

A.E.Kay

537.3

7059 THE DAMPING METHOD IN THE THEORY OF ELECTRICAL CONDUCTIVITY.

R.Zigenlaub.

Fiz. tverdogo Tela, Vol. 1, No. 7, 1053-61 (July, 1959). In Russian.

A method is proposed for calculating the electrical conductivity tensor which is similar to the damping method in quantum field theory. The case where the interaction term in the Hamiltonian contains a small parameter is examined. The method is considered to possess several important advantages compared with the normal kinetic equation method.

R.Berman

537.3

7060 A METHOD OF CALCULATION OF ELECTRICAL CONDUCTIVITY.

H.Nakano.

Progr. theor. Phys., Vol. 17, No. 2, 145-61 (Feb., 1957).

A new method of calculating electrical conductivity is presented.

The method is based on the theory of relaxation function or after-effect function, from which the general formula for the electrical conductivity is obtained. Taking into account a time required for an observation, irreversibility is introduced into the theory and investigation is made of the relaxational behaviour of the process, from which the electrical conductivity is calculated and the practical expression is obtained. In the perturbation approximation the result is the same as the expression obtained on the basis of the Bloch theory.

537.3 : 534.22

7061 ELECTRICAL CONDUCTIVITY OF THE EXPLOSION PRODUCTS OF CONDENSED EXPLOSIVES.

A.A.Brish, M.S.Tarasov and V.A.Tsukerman.
Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1543-50 (Dec., 1959).
In Russian.

The electrical conductivity of the explosion products of various condensed explosives was investigated by the electrical contact and electromagnetic methods. Near the wave-front the conductivity of the investigated explosives lies between 0.1 and 6 Ω^{-1} cm^{-1}. With increase of the distance from the front the conductivity of the explosion products drops, but it increases with rise of the density of the explosives and intensity of the detonation wave. It is suggested that, apart from thermal ionization, the high values of the electrical conductivity of the explosion products may be due to the large densities and pressures at the detonation wave-front.

537.3 : 621.316.721

7062 HIGH PRECISION LARGE CURRENT REGULATOR.

K.C.Brog and F.J.Milford.
Rev. sci. Instrum., Vol. 31, No. 3, 321-2 (March, 1960).

A versatile high current regulator using transistors for the series regulating element and capable of accuracies of a few parts per million is described. A solid state d.c. power supply capable of delivering 50 A at 50 V also is described. The performance of the system as a magnet current regulator is discussed briefly.

537.3 : 519

7063 FOURIER SERIES ASSOCIATED WITH DUTY CYCLES.

C.G.Mayo and J.W.Head.
Brit. J. appl. Phys., Vol. 11, No. 3, 103-6 (March, 1960).

An arbitrary function $F(\theta)$ of period 2π may be divided (by "time multiplex") into n parts $H_kF(\theta)[k = 0, 1 \dots (n-1)]$ each of which is only different from zero for 1/n-th of the cycle [when $2k\pi/n < \theta < (2k+2)\pi/n$] and is then equal to $F(\theta)$. The Fourier series for $F(\theta)$ (in its exponential form) may also be divided (by "frequency multiplex") into n sub-series $F_u(\theta)$ $(u = 0, 1 \dots n-1)$ each of which contains only every n-th term of the series for $F(\theta)$, that is to say, terms involving $\exp(sn + u)i\theta$ where s is an integer. A relation is established between the time-multiplex sub-divisions $H_kF(\theta)$ and the frequency-multiplex subdivisions $F_u(\theta)$ and special cases are considered, namely (a) all the $H_kF(\theta)$ zero except one, (b) $F(\theta)$ constant for 1/n-th of the cycle and otherwise zero, when the behaviour of the series obtained can be checked by contour-integration methods of series summation. In case (a) all the $F_u(\theta)$ are equal while $F(\theta)$ is different from zero, and mutually cancel otherwise.

537.3

7064 A PARADOX CONCERNING THERMAL FLUCTUATIONS IN NON-LINEAR SYSTEMS. A.Marek.

Czech. J. Phys., Vol. 9, No. 2, 260-2 (1959).

Draws attention to the question, apparently as yet unanswered, as to why a diode does not rectify the thermal noise voltage generated in a resistance connected across it, in conflict, it is said, with the second law of thermodynamics. F.F.Roberts

537.3

7065 FUNDAMENTAL STUDY OF ATOMIC BATTERY.

C.Yamanaka, H.Wada and Y. Yamamura.
Technol. Rep. Osaka Univ., Vol. 8, 233-41 (Oct., 1958).

Electron-voltaic effect in Ge diffused p—n junctions was measured to clarify the fundamental behaviour of an atomic battery. The radiation damage in cell crystals is an important problem to be solved for practical use. The damage and annealing cycles of p—n junctions were studied at various temperatures. The Ge p—n junction seems to be free from radiation damage at room temperatures. The damage in Si crystal was also measured. The tests are sufficiently satisfactory to enable the design of a standard atomic battery to be considered.

537.3 : 621.313.066.6

7066 THERMAL TRANSIENTS IN GRAPHITE—COPPER CONTACTS. W.Davies.

Brit. J. appl. Phys., Vol. 10, No. 12, 516-22 (Dec., 1959).

Calculation of the transient temperature distribution in a current-carrying electric contact is important in those cases in which the contact members make actual contact for only a comparatively short time. Special reference is made here to the contact of graphite and copper, and consideration is given firstly to the case in which the metal is clean, and secondly to that in which the metal is covered with a film of oxide. Finally, the decay of the temperature at a contact spot following the separation of the contact member is discussed. The analysis treats of a single circular contact spot of very small radius.

537.3 : 621.383.42

7067 INTERNAL RESISTANCES AND CAPACITANCE OF A SELENIUM PHOTOCELL AT LOW TEMPERATURES.

G.Blet.
J. Phys. Radium, Vol. 18, No. 10, 572-8 (Oct., 1957). In French.

The variations of capacitance of a photocell at low temperatures display phenomena similar to those observed for variations of resistance. Resensitization by means of near infrared also gives similar results. The two quantities, R and C, seem to be intimatel associated and depend directly on the concentration of free electrons at a particular energy level, which has been evaluated.

537.32 : 621.317.39

7068 DEVELOPMENT OF A SPECIAL THERMOCOUPLE FOR MEASURING TRANSIENT TEMPERATURES WITHIN A SOLID BODY. J.D.Clem, Jr.

Rev. sci. Instrum., Vol. 31, No. 3, 334-6 (March, 1960).

A special thermocouple was developed to measure transient temperatures at relatively large distances within the walls of uncooled rocket nozzles. The device, known as a thermoplug, was designed to cause a minimum disturbance of the temperature field. Results of limited experiments indicate the design to be adequate for the purpose for which it was developed. All development work was done using a homogeneous metallic nozzle, but the design could be adapted readily to nonmetallic or composite nozzle walls. The thermoplug may be fabricated in the laboratory and should be adaptable to many internal temperature measurements not connected with rocket propulsion units.

IONIZATION

537.5

7069 EXCITATION AND IONIZATION RATES OF MERCURY IN DISCHARGE PLASMAS. M.A.Cayless.

Brit. J. appl. Phys., Vol. 10, No. 4, 186-90 (April, 1959).

Excitation and ionization rates of mercury by inelastic electron collisions in gas discharge plasmas with Maxwellian electron energy distributions have been calculated from the collision cross-section data for electron temperatures between 5000 and 54 000°K. Published cross-section data have been used where available, and estimates have been made in several cases of interest for which no data are known.

537.5

7070 MULTIPLE IONIZATION OF RARE GASES BY ELECTRON IMPACT.

M.Krauss, R.M.Reese and V.H.Dibeler.
J. Res. Nat. Bur. Stand., Vol. 63A, No. 3, 201-4 (Nov.-Dec., 1959).

Electron impact studies of multiple ionization processes in helium, neon, argon and xenon appear to support theoretical conclusions that the threshold probability for n-fold ionization is proportional to the nth power of the electron energy in excess of the threshold energy. The probability law applies, for the cases studied over a considerable energy range that, for all but He^{2+}, includes the possible onset of more than one mode of ionization. The presence of a Boltzmann spread in the energy of the electron beam or specific focusing effects due to ion source geometry are found to affect only the foot of the probability curve. By the use of certain assumptions, an estimate is also made of the departure from a ^3P ionization probability curve resulting from onset of ionization to the ^1D and ^1S states.

537.56

7071 EFFICIENCY OF FIELD IONIZATION AT A METAL SURFACE.

H.Fiedeldey and D.Fourie.

Phys. Rev., Vol. 117, No. 4, 924-8 (Feb. 15, 1960).

The expression for the transmission coefficient, which was derived formerly by Müller (Abstr. 5159 of 1956) for field emission, is integrated by making certain approximations. The formula for the efficiency of field ionization could then be integrated. Furthermore the supply function is calculated by regarding the molecule as moving in a central field of force. The main object of the paper is that of deriving analytical formulae which give a better picture of the dependence of the field ion current on the various parameters.

537.56

7072 USE OF CONSTANT-BOILING SYSTEMS IN CALIBRATION OF MASS SPECTROMETERS AND OTHER MOLECULAR BEAM INSTRUMENTS.

A.W.Searcy, W.S.Williams and P.O.Schissel.

J. chem. Phys., Vol. 32, No. 3, 957-8 (March, 1960).

Any change in composition ratio affects the measurement of lifetimes for excited particle states or of cross-section for reactions in a molecular beam. For constant-boiling compounds at equilibrium where vaporization involves dissociation, only the formulae of the dissociation products need be determined to arrive at the flux ratio of these gas species. For TiB_2, for example, the flux ratio equals 2. In a mass spectrometer the only ions formed by 40 eV electrons were Ti^+ and B^+. No significant temperature variation in the ratio was found, while the intensities of the Ti and B atoms each changed by two orders of magnitude. The average observed intensity ratio was 3.8 with an estimated uncertainty of ±20%. The cross-section ratio of 7.6 ± 1.5 thus determined compares with a calculated value of 7.3.

R.Schnurmann

537.56 : 551.5

7073 CHARGE EQUILIBRIUM IN AEROSOLS ACCORDING TO THE BOLTZMANN LAW.

D.Keefe, P.J.Nolan and T.A.Rich.

Proc. Roy. Irish Acad. A, Vol. 60, No. 4, 27-45 (July, 1959).

The consequences are examined of treating charged aerosol particles as having an excess energy due to their charge and applying the Boltzmann distribution law to their equilibrium with small ions. The results are found to be in agreement with the available experimental determinations in the range $4 \times 10^{-6} < r < 14 \times 10^{-6}$ cm. For radii greater than 2×10^{-6} cm a simple formula is established: $Z/N_0 = K\sqrt{r}$, where $K = \sqrt{(2\pi\kappa T/\epsilon^2)}^{1/2}$. For large particles, it is found that the average number of elementary charges per particle is $= \pi^{-1}(Z/N_0)$ and that the average charge per particle is $\sqrt{(2r\kappa T/\pi)}^{1/2}$. It is shown that the average electrical energy per particle is $\frac{1}{2}\kappa T$ and thus that equipartition exists between the electrical and mechanical degrees of freedom. Simple formulae are deduced for the ratios of the various combination coefficients of particles and ions. These are found to agree for large particles with formulae for combination coefficients established by Harper, Pluvinage, Bricard and Gunn. For large particles a difference formula of the Whipple type is found to hold approximately, bu the difference is one-half that proposed by Whipple for smaller particles. A new way of arriving at combination coefficient ratios by a consideration of the distortion of ionic trajectories is described and found to give satisfactory results for large particles when the effect of image charges is taken into account. For particles and condensation nuclei less than about 10^{-6} cm in radius, difficulties arise in applying the equation for coefficient ratios. The implications of the apparent inapplicability of the Boltzmann Law to very small particles are discussed.

537.56

7074 DRIFT VELOCITY OF ELECTRONS IN NITROGEN, HELIUM, NEON, ARGON, KRYPTON, AND XENON.

J.C.Bowe.

Phys. Rev., Vol. 117, No. 6, 1411-15 (March 15, 1960).

Accurate values of electron drift-velocity in purified noble gases and nitrogen were obtained by measuring the transit time of photoelectrons across the gap of a parallel-plate condenser. Drift velocities in pure krypton and xenon have not been measured before. The values obtained for the other gases are invariably lower than those reported by Nielsen, the discrepancy for neon being large. The sharp maximum found by English and Hanna for argon at $E/p_0 < 0.1$ and tentatively ascribed by them to the Ramsauer effect was not observed in the purified gas.

537.56

7075 TRANSPORT COLLISION CROSS SECTIONS FROM ELECTRON DRIFT-VELOCITY DATA.

J.C.Bowe.

Phys. Rev., Vol. 117, No. 6, 1416-20 (March 15, 1960).

Information concerning the transport collision cross-section $\sigma_t(\epsilon)$ of low-energy electrons in the noble gases was obtained from drift-velocity data (preceding abstract). The results (with ϵ in eV) are He: $\sigma_t(\epsilon) = (28 \pm 1)$ cm^{-1} for $0.13 \leq \epsilon \leq 4$; Ne: $\sigma_t(\epsilon) = (6.05)\,\epsilon^{0.157}$ cm^{-1} for $0.38 \leq \epsilon \leq 8$; A: $\sigma(\epsilon) = (6.3 \pm 0.6)\,\epsilon$ cm^{-1} for $1.6 \leq \epsilon \leq 11$; Kr: $\sigma_t(\epsilon) = 14\epsilon$ cm^{-1} for $1.6 \leq \epsilon \leq 3$; Xe: $\sigma_t(\epsilon) = 26\epsilon$ cm^{-1} for $1 \leq \epsilon \leq 2.4$. All σ_t values are for 0°C and 1 mm Hg pressure. These results are compared with other experimental and theoretical data. For nitrogen the drift-velocity measurements indicate an average fractional energy loss per collision of $20(2m/M)$ in the energy range $\epsilon = 0.07$ to 0.15 eV.

537.56

7076 FREE—FREE ABSORPTION COEFFICIENT OF THE NEGATIVE HYDROGEN ION.

T.Ohmura and H.Ohmura.

Astrophys. J., Vol. 131, No. 1, 8-11 (Jan., 1960).

It is shown that the free—free transition matrix element of the negative hydrogen ion can be expressed, within an accuracy of the order of 1%, in terms of the S-phase shifts of the electron—hydrogen atom scattering. Hence the continuous absorption coefficient due to the free—free transition including the exchange and the correlation effects in the S-states can be calculated from a knowledge of the S-phase shifts alone. The new values of the free—free coefficient are of 40 ~ 50% less than the ones computed by Chandrasekhar and Breen, who used the Hartree functions without exchange.

537.56

7077 ELECTRON DETACHMENT FROM THE NEGATIVE HYDROGEN ION BY ELECTRON IMPACT.

S.Geltman.

Proc. Phys. Soc., Vol. 75, Pt 1, 67-76 (Jan., 1960).

The Born—Oppenheimer approximation has been used to evaluate the cross-section for the detachment of electrons from H^- by electron impact over an energy range from threshold (0.75 eV) to 75 eV. An empirical correction was then applied to account approximately for the long-range Coulomb repulsion between the incident electron and the negative ion. The resulting cross-section has a broad maximum of $700\pi a_0^2$ centred at about 45 eV.

537.56

7078 ELECTRON CAPTURE BY PROTONS PASSING THROUGH HYDROGEN.

N.C.Sil.

Proc. Phys. Soc., Vol. 75, Pt 2, 194-200 (Feb., 1960).

A variational method is applied to the problem of electron capture by protons from the ground state of hydrogen atoms. The problem is treated as a simplified one-body problem, viz. that of an electron in the Coulomb field of two protons, the proton—proton interaction being neglected. The numerical results obtained for low incident proton energies are in good agreement with the recent experimental findings of Fite, Brackmann and Snow (1958). At low incident proton energies the author's theoretical results agree closely with those of Dalgarno and Yadav (1953), though the methods of approach are different. Further, the author's results may, with suitable approximations, be easily reduced to those of Brinkman and Kramers (1930), or of Bates and Dalgarno (1952,1953) and Jackson and Schiff (1953).

537.56

7079 ELECTRON CAPTURE AND LOSS IN COLLISIONS OF FAST HELIUM, BORON AND FLUORINE ATOMS WITH GAS MOLECULES.

Ya.M.Fogel', V.A.Ankudinov and D.V.Pilipenko.

Zh. eksper. teor. Fiz., Vol. 38, No. 1, 26-32 (Jan., 1960). In Russian.

Measured values are given for the cross-sections σ_{0-1} and σ_{01} of electron capture and loss by fast He, B and F atoms (with 10 to 60 keV energies) in collisions with inert-gas atoms. It is shown that the shape of σ_{0-1} (v) curves and the position of their maxima can be explained in terms of the Massey adiabatic hypothesis. In the case of He atoms the shape of the curve is affected by admixture of metastable He atoms in the primary beam. The adiabatic hypothesis cannot be applied to electron loss by fast atoms.

ELECTRIC DISCHARGES

537.52

7080 THEORY OF DIFFUSION WAVES. II. AMPLIFICATION CONDITIONS IN LOW PRESSURE DISCHARGES.

H.Rother.
Ann. Phys. (Leipzig), Folge 7, Vol. 5, No. 5-6, 252-67 (1960).
In German.

The propagation of space charge disturbances in glow discharges is discussed. Amplification effects occur in conditions when charge carrier production and wall losses do not vary linearly with electron density. The importance of step-wise ionization (multiple collisions) is considered. Moving striations are shown to be limited to certain ranges of parameters (current etc.). Higher-pressure conditions are also discussed. For Pt I see Abstr. 248 (1960).
J.D.Craggs

537.52

7081 STUDIES ON THE CLARIFICATION OF THE MECHANISM OF THE DOUBLE-CATHODE EFFECT.

E.Bădareu, I.Popescu and I.Iova.
Ann. Phys. (Leipzig), Folge 7, Vol. 5, No. 5-6, 308-26 (1960).
In German.

Describes an extensive theoretical and experimental study of the hollow-cathode effect, set up between an anode and two plane parallel cathodes with axes normal to the anode surface. In abnormal discharge conditions most of the excitation and ionization occurs in the negative glow. A.H.W.Beck

537.52

7082 MOVING STRIATIONS OF SMALL AMPLITUDE IN LOW PRESSURE ARGON DISCHARGES. K.Wojaczek.

Acta phys. Hungar., Vol. 11, No. 1, 35-45 (1960). In German.

Probe studies are reported and detailed results are given for a pressure of 0.5 mm Hg, of wavelength — frequency and amplification —frequency relations. Frequencies varied from about 1400-2000 c/s. The data compare satisfactorily with theoretical predictions.
J.D.Craggs

537.52

7083 THE EFFECT OF ANODE DISTURBANCES ON THE POSITIVE COLUMN OF LOW PRESSURE GASEOUS DISCHARGES. G.Szigeti and J.Bitó.

Acta phys. Hungar., Vol. 11, No. 1, 103 (1960). In German.

A very brief note comparing contributions by various previous authors. J.D.Craggs

537.52 : 539.12 : 621.387

7084 PRODUCTION OF X-RAYS DURING A LOW-PRESSURE GAS DISCHARGE. R.F.Thumwood.

Brit. J. appl. Phys., Vol. 10, No. 3, 147-51 (March, 1959).

The impulse breakdown of several gases at pressures of a few microns of mercury has been investigated. During the first stage of the discharge, a microsecond burst of X-rays is emitted from a spot of about 8 mm diameter on the anode electrode. If the initial voltage applied to the tube is 600 kV, a single X-ray pulse will produce a legible radiograph through about 5 cm of steel. The mechanism of the discharge has been studied and high-speed photographs of the visible discharge show a luminous column moving from cathode to anode. Steenbeck's theory has been extended to show qualitatively the probable sequence of events during the discharge.

537.52 : 621.387

7085 GLOW DISCHARGE CHARACTERISTICS OF HELIUM—NEON MIXTURES. G.F.Weston.

Brit. J. appl. Phys., Vol. 10, No. 12, 523-6 (Dec., 1959).

The maintaining and breakdown potentials for a number of helium—neon mixtures have been determined over a pressure × distance (pd) range of 1 to 75 cm mm of mercury. The normal cathode fall and the minimum breakdown potential were higher for mixtures containing from 1 to 5% neon, than for either of the pure gases. At higher pd values the breakdown potential was lower for mixtures of the order of 50% helium - 50% neon than for the pure gases. These results suggest reactions between the two gases affecting the ionization coefficients. Charge exchange processes, detected by Oskam in the afterglow of such mixtures, are consistent with the emission spectra of the glow discharges, and are the probable cause of the variations.

537.5

7086 THE INFLUENCE OF A H.F. FIELD ON THE HOMOGENEOUS POSITIVE COLUMN OF A D.C. GLOW DISCHARGE. M.Šícha.

Czech. J. Phys., Vol. 9, No. 1, 124-5 (1959). In Russian.

Gives a very brief account of an experimental investigation of the formation of stationary striations in neon (2mm of Hg), when a high frequency discharge was superposed on a homogeneous d.c. glow discharge. A similar effect was observed with air.
J.M.Zarzyck

537.52

7087 THE STABILITY OF HIGH-CURRENT GLOW DISCHARGES. W.Weizel and B.Brandt.

Forschungsber. Wirtsch.-Verkehrsmin. Nordrhein-Westfalen, No. 267, 25 pp (1956). In German.

A general qualitative discussion of the problem, in terms of glow—arc transitions and cathode effects, etc. J.D.Craggs

537.5

7088 EFFECT OF THE PROCESSES OF DISAPPEARANCE OF NEGATIVE IONS ON THEIR CONCENTRATION IN A [POSITIVE] COLUMN. M.V.Konyukov.

Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 23, No. 8, 971-4 (1959).
In Russian.

In the positive column of a discharge in electronegative gases and their mixtures the negative component of the plasma consists o electrons and negative ions. The present theoretical paper is concerned with the effect of decay processes of negative ions upon thei concentration. C.R.S.Mander

537.5

7089 LOW FREQUENCY WAVEFORM PHENOMENA IN THE PLASMA OF A GLOW DISCHARGE. L.Pekarek.

Izv. Akad. Nauk SSSR, Ser fiz., Vol. 23, No. 8, 1050-2 (1959).
In Russian.

The conditions were arranged in a Hydrogen discharge tube so that the positive column was quite uniform and not characterized by moving striae. A metal ring was placed round outside the tube at the position of the positive column. When a h.f. voltage of sufficient amplitude was connected to the ring steady striations were set up in the positive column on the anode side of the ring. If instea a single electric pulse be applied to the metal ring a pulse of reduc light intensity can be shown to travel along the positive column, followed by the occurrence of striations on the anode side. Other phen mena are also quoted but no explanations are offered.
C.R.S.Mander

537.52 : 621.38

7090 PREPARATION OF ANODIC OSCILLATOR TUBE USIN GLOW DISCHARGE. K.Ogawa.

J. Phys. Soc. Japan, Vol. 14, No. 3, 385-6 (March, 1959).

Describes the construction and gas filling techniques for the production of relaxation (anode) oscillator tubes. The gas fillings were Ne or A (~ 50 mm Hg pressure) and for tube currents of 2 - 20 mA the oscillation frequency was 8 - 14.5 kc/s.
J.D.Cragg

537.

7091 THE CURRENT SHEET IN A GAS DISCHARGE. N.J.Phillips.

Proc. Phys. Soc., Vol. 74, Pt 6, 700-4 (Dec., 1959).

A simple theory of the trapping of gas in a "fast-pinch" gas discharge is given. In the early stages of a gas discharge, a sheet of current flows near the walls of the discharge tube. This sheet subsequently collapses on to the cold gas inside it, with the consequent compression of the gas. It is shown that the efficiency of the trapping of the cold gas within the sheet during the collapse stage increases with the initial gas density.

537.5

7092 COLD-CATHODE ELECTRIC DISCHARGE AT LOW PRESSURES IN A MAGNETIC FIELD.

G.V.Smirnitskaya and É.M.Reikhrudel'.
Zh. tekh. Fiz., Vol. 29, No. 2, 153-62 (Feb., 1959). In Russian:
English translation in: Soviet Physics-Technical Physics (New Yo
Vol. 4, No. 2, 131-9 (Feb., 1959).

Theoretical and experimental studies were made on a tube wit cold-cathode disks placed symmetrically on both sides of a ring anode. A theoretical calculation is made of the electron kinetics fo the case in which there is no distortion of the field by space charg

The potential distribution is taken from experimental data. Electron trajectories are obtained with arbitrary initial coordinates and velocities and for various ratios of the electric and magnetic fields. An examination of the dependence of the ignition potential on the magnetic field confirms the correctness of the theoretical results.

537.52

7093 THE EFFECT OF A UNIFORM MAGNETIC FIELD ON ELECTRODELESS DISCHARGE IN A TUBE AND MEASUREMENT OF ELECTRONIC MOBILITY. I. AIR.

S.N.Goswami.
Indian J. Phys., Vol. 32, No. 1, 35-41 (Jan., 1958).

Results of measurements of the percentage increase in the breakdown potential in a discharge tube filled with dry air and excited with 50 c/s alternating voltage, under a uniform magnetic field, and of the electronic mobility have been reported. Measurements are made for different pressures and under magnetic fields inclined at different angles with the electric field. Results are discussed from the standpoint of the theory proposed by Deb and Goswami (1956).

537.52

7094 THE EFFECT OF A UNIFORM MAGNETIC FIELD ON ELECTRODELESS DISCHARGE IN A TUBE AND MEASUREMENT OF ELECTRONIC MOBILITY. II. OXYGEN, NITROGEN, CARBON DIOXIDE AND HYDROGEN.

S.N.Goswami.
Indian J. Phys., Vol. 32, No. 5, 241-8 (May, 1958).

Results of measurements of the percentage increase in the breakdown potential and of electronic mobility in a discharge tube filled with O_2, N_2, CO_2 and H_2, and excited with a 50 c/s alternating voltage, under a uniform magnetic field have been reported. Measurements are made at different pressures and under magnetic fields inclined at different angles with the electric field.

537.52

7095 THE FALLING CURRENT POTENTIAL CHARACTERISTIC IN HYDROGEN UNDER SILENT ELECTRIC DISCHARGE.

D.P.Jatar.
J. sci. Res. Banaras Hindu Univ., Vol. 8(2), 215-33 (June, 1958).

Further detailed series of experiments are described, using hydrogen in Siemen's ozonizer tubes, on the Joshi effect, i.e. the influence of external irradiation on corona discharges.

J.D.Craggs

537.52

7096 JOSHI EFFECT IN AIR AND THE ASSOCIATED CHANGE IN THE LIGHT OUTPUT.

D.P.Jatar and H.D.Sharma.
J. sci. Res. Banaras Hindu Univ., Vol. 8(2), 234-42 (1957-58: publ. June, 1958).

Experimental results are given for the variation with voltage of the current in, and the intensity of light output from, a.c. "ozonizer tube" corona discharges, with and without external illumination. The results are briefly discussed in terms of photo-denudation of the cathode and neutralization of the space charge. J.Dutton

537.52

7097 ON THE PROBLEM OF THE VOLUME OF METAL MELTED DURING ELECTRICAL DISCHARGE EROSION.

A.S.Zingerman.
Fiz. tverdogo Tela, Vol. 1, No. 2, 284-9 (Feb., 1959). In Russian.

Theoretical. It was shown that the depth, h, of the molten zone formed in a metal electrode as a result of an electrical discharge can be determined from the equation : $T_p + q_k \eta / c = \varphi(t,h)$, where : $\varphi(t,h)$ is the solution of the appropriate differential equation (not taking into account the latent heat of fusion) satisfying the initial conditions; t the duration of the discharge; T_p the melting point of the metal; q_k the latent heat of fusion; c the specific heat; η a coefficient taking into account the latent heat of fusion. If it is assumed that $\eta = 0.5$, and if the distance between Al or Fe electrodes $\leq$ 100-150μ the calculated results are accurate within 3-7%. If the diameter of the discharge channel $\geq 6\sqrt{at}$ (a, the heat conductivity coeff., equals ratio thermal conductivity to product of density and specific heat), the heat source can be regarded as infinite; such an assumption leads to an error of ~ 4%. M.H Sloboda

537.52

7098 APPROXIMATE SOLUTION OF A NON-LINEAR DIFFERENTIAL EQUATION GIVING THE TEMPERATURE DISTRIBUTION IN THE POSITIVE COLUMN OF A STATIC ARC.

H.Goldenberg.
Brit. J. appl. Phys., Vol. 10, No. 1, 47-51 (Jan., 1959).

Heat conduction only is taken into account. The method of Eyres, Hartree and others (Abstr. 608 of 1947) is first used to change the dependent variable in order to replace the two non-linear functions of temperature present in the differential equation, namely the electrical and thermal conductivities, by a single non-linear function. When this non-linear function is approximated by a piecewise linear function, the basic differential equation can be integrated directly, and the temperature profile obtained. An example shows close agreement with King's results. [Theoretical calculation of arc temperatures is gases, Colloquium Spectroscopicum Internationale VI (Amsterdam, 1956) p. 152 London : Pergamon Press (1957). Based on E.R.A. Report Ref. G/XT 155 (Abstr. 3531 of 1959)].

537.52 : 621.387

7099 THE MAGNETIC STABILIZATION OF LOW PRESSURE D.C. ARCS. H.Wroe.

Brit. J. appl. Phys., Vol. 9, No. 12, 488-91 (Dec., 1958).

Self-sustaining d.c. arc discharges between solid metal electrodes at pressures down to 10^{-4} mm of mercury have been investigated. At pressures below a few millimetres of mercury, arcs on both refractory and non-refractory metals behaved like cold-cathode arcs. "Spot-splitting" and "reverse driving" of the cathode spot were observed and a form of instability is described. Reverse driving of the cathode spot or spots by the magnetic field set up by the current in the electrodes themselves is suggested as the cause of the instability. A magnetic method of stabilizing the discharge is described, requiring an axial magnetic field of at least 500 G. A marked constriction of the positive column was caused with this value of field. The magnetically stabilized discharge has been used experimentally to produce short welds on $\frac{1}{8}$ in. thick mild steel plate at 1 μ of mercury pressure using about 40 A at 30 V.

537.52

7100 PROBE INVESTIGATIONS OF THE FIELD OF AN A.C. CORONA. V.I.Levitov, A.G.Lyapin and V.I.Popkov.

Izv. Akad. Nauk SSSR, Ser fiz., Vol. 23, No. 8, 980-8 (1959).
In Russian.

An attempt to clarify the methodology of probe investigations. Two like cylindrical probes are arranged in the fields under study, symmetrically about an electrode. This differential probe arrange ment eliminates effects done to convection and displacement currents. If in the circuit of one probe a d.c. source is included (carrier potential), the balance of the differential probe arrangement is upset and there is a difference in the currents to the two probes. The effect is investigated of the carrier potential upon the separate constituents of the probe current. The probe arrangement is found to have negligible effect on the main discharge. Curves are given of volt—ampere characteristics of the differential probe, together with ρk versus t, space potential and space charge curves.

C.R.S.Manders

537.52 : 621.315.1

7101 EFFECT OF CORONA ON TRAVELLING WAVES.

M.Ouyang.
Nature (London), Vol. 185, 524-5 (Feb. 20, 1960).

Observations of wave shape distortion along a 33 kV overhead line suggest that the corona discharge is quenched by its own space charge. C.G.Morgan

537.52

7102 INVESTIGATION OF THE INITIAL STAGES OF A HIGH-FREQUENCY DISCHARGE FROM A POINT IN AIR AT ATMOSPHERIC PRESSURE.

A.M.Prokof'ev, O.F.Kabardin and K.F.Kuddu.
Izv. Akad. Nauk SSSR, Ser fiz.,., Vol. 23, No. 8, 1004-6 (1959).
In Russian.

Describes experiments designed to check that the initial stages of a h.f. point-to-plane discharge have much in common with the d.c. corona. At minimum voltages a discharge similar to a 1.25-40 Mc/s discharge from a point in air at atmospheric pressure can be developed both from the preliminary streamer of a positive corona, and also from a Trichel pulse of a negative corona. C.R.S.Manders

537.52

7103 THE PROBABILITY OF STREAMER CHANNEL FORMATION FROM A LARGE ELECTRON AVALANCHE.

K.Richter.
Z. Phys., Vol. 158, No. 3, 312-21 (1960). In German.

Investigations on avalanches of large carrier number ($> 10^8$)

show the following characteristic features of the streamer mechanism known as "channel build-up" (Kanal-Aufbau). (1) An avalanche can only start a streamer, if the carrier number of the avalanche has reached a certain critical value n_{crit}. Having exceeded n_{crit}, the probability of this streamer formation increases monotonously with increasing carrier number. The applied field E_0 is kept constant. (2) The probability of streamer formation for a constant carrier number of the avalanche increases with the applied field. The critical carrier number can therefore be reduced by increasing the applied field. (3) As a consequence of this behaviour of individual avalanches, the mean probability of an electron running through the gap to start a streamer increases if the mean value of amplification ($\exp \alpha d$) increases or (what is in this case identical) if the applied field is increased. There is a critical mean value of amplification, below which it is impossible to observe any streamer formation. (4) If the carrier number of an avalanche reaches $n \cong 10^8$, a process comes into being which is characterized by an increase of ionization.

537.52

7104 **THE EXPANSION OF A HEAVY SPARK CHANNEL IN A LIQUID.** V.S.Komel'kov and Yu.V.Skvortsov.
Dokl. Akad. Nauk SSSR, Vol. 129, No. 6, 1273-6 (Dec. 21, 1959). In Russian.

Describes experiments in which a discharge was excited in water along the axis of a cylindrical glass chamber of diameter 40-70 mm and height 50 mm between needle-type brass electrodes with 12-15 mm separation The current circuit, of capacity 2.7-260 μF and voltage 20-40 kV, was discharged through a circuit of inductance 7×10^{-6} - 10^{-7} H. Current amplitudes up to 720 kA and slopes up to 2.1×10^{11} A/sec were attained. Figures include energy liberated in spark channel against time, initial speed of energy liberation against current slope, current density in spark against time, and energy per unit volume of channel against current slope. D.E.Brown

537.52 : 536.58

7105 **OBTAINING HIGH TEMPERATURES BY MEANS OF A SPARK DISCHARGE.** M.P.Vanyukov and A.A.Mak.
Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 23, No. 8, 962-4 (1959). In Russian.

The spark temperatures were investigated by measuring the brightness of spectral lines from spark discharges in argon, xenon and nitrogen at pressures ≥ 2 atmospheres. It is concluded that the temperature of the spark remains unchanged over a large range of rates of energy dissipation in the channel and that there are no considerable temperature gradients across the channel section. Z.Krasucki

537.52

7106 **THE INFLUENCE OF IONIZING RADIATIONS ON SPARK BREAKDOWN AT ATMOSPHERIC PRESSURE.**
J.L.Azéma.
Rev. gen. Elect., Vol. 68, No. 12, 673-92 (Dec., 1959). In French.

First reviews the theoretical background of spark breakdown processes (Townsend theory, space charge effects etc.), then gives an account of an exhaustive series of experiments with sphere gaps. The disturbing effect of nearby surfaces was studied in detail and results are given. The influence of irradiation (u.v. light and Co^{60} γ-rays) on breakdown probability in given conditions is also treated at length. J.D.Craggs

537.52 : 621.316.933.4

7107 **SOME PROPERTIES OF A GRADED VACUUM SPARK GAP.** J.W.Mather and A.H.Williams.
Rev. sci. Instrum., Vol. 31, No. 3, 297-304 (March, 1960).

A high power, low inductance vacuum spark gap combination (crowbar and main switch) is described which is capable of d.c. operation over a wide voltage range. The electrical properties are discussed in regard to shorting and multiple switch operation. The principal difficulty of vacuum spark gaps, the coating of the inner surface of the insulator with evaporated and sputtered electrode material, is absent in this design after conditioning. A mechanism to account for this, based on the establishment of a large number of nucleation centres on the insulating walls, is shown to be consistent with observations.

537.52 : 621.374.44

7108 **MILLIMICROSECOND TRIGGERING OF HIGH VOLTAGE SPARK GAPS.** G.A.Theophanis.
Rev. sci. Instrum., Vol. 31, No. 4, 427-32 (April, 1960).

Pulse transformers often are employed in circuits which are used to trigger spark gaps. There are limitations in the use of this type of generator when a high degree of accuracy is desired. When operating light sources in conjunction with Kerr cell shutters, synchronization of the light sources and shutter must be accomplished with a jitter of no more than a few millimicroseconds. Pulse requirements and spark gap conditions for millimicrosecond triggering are defined. Several transformerless trigger pulse generators are described. One of these has been used to trigger 50 kV spark gaps with jitter times as low as 2 mμsec. A number of techniques for synchronizing the firing of spark gaps are discussed and some uses of these techniques are given. Several methods for pulsing Kerr cells using accurately triggered spark gaps are described.

537.52 : 536.46

7109 **TEMPERATURE AND IGNITION CAPABILITY OF FRICTION SPARKS IN DIFFERENT GAS MIXTURES.**
H.Wahl.
Z. angew. Phys., Vol. 12, No. 2, 60-2 (Feb., 1960). In German.

Comparison of the light intensity at two different wavelengths enable measurements to be made of the temperature of friction "sparks" produced by pressing a steel needle against a rapidly rotating corundum disc in mixtures of air with such gases as CH_4, H_2, CH_3OH etc. Whether such a mixture ignites is found to be more dependent on the concentration ratio than on the temperature, and the limits of the concentration ratio for which ignition occurs are given in each case; no ignition occurs for ethyl ether—air mixtures. J.Dutton

537.52 : 621.319.5

7110 **SUPPRESSION OF COUNTER-EMISSION IN COMPRESSED AIR. APPLICATION TO HIGH-VOLTAGE GENERATORS AND ELECTROFILTERS.** Nguyen-Trinh Dzoanh.
C.R. Acad. Sci. (Paris), Vol. 250, No. 6, 1001-3 (Feb. 8, 1960). In French.

The undesirable effect of counter-emission in the functioning of high-voltage generators and electrofilters is briefly discussed. Some results are presented which were obtained using an experimental arrangement consisting of a fine wire surrounded by a coaxial cylinder, the inner surface of the latter being covered with fine nylon clot to initiate counter-emission. These indicate that counter-emission can be suppressed by using air, for example, at pressures of several kg/cm^2. Finally the advantages of using compressed gases in high-voltage generators and electrofilters are summarized. A.E.Kay

PLASMA

537.56

7111 **THE RADIAL DISTRIBUTION OF CHARGE CARRIERS IN A [PLASMA] COLUMN WITH SEVERAL TYPES OF POSITIVE IONS.** J.Wilhelm.
Ann. Phys. (Leipzig), Folge 7, Vol. 5, No. 3-4, 129-43 (1960). In German.

A detailed theoretical treatment of diffusion processes in discharge plasmas, in relation to the radial variation of particle specie (e.g. metastable atoms). The equations are set up for two kinds of ions, ionization by metastable atom collisions and for change of charge processes. J.D.Craggs

537.56

7112 **ROTATING MAGNETIC POLARIZATION IN PLASMAS. APPLICATION TO THE MEASUREMENT OF ELECTRON DENSITY.** T.Consoli and M.Dagai.
C.R. Acad. Sci. (Paris), Vol. 250, No. 6, 1010-12 (Feb. 8, 1960). In French.

A theoretical examination of the rotation of the electric field vector of a linearly polarized wave propagated in a plasma parallel to the direction of an applied magnetic field. It is claimed that this leads to a method whereby electron densities in the range 10^8 to 10^{24} e/m^3 (electrons/metre cube) can be determined for applie magnetic fields of 10^{-4} G to 10^4 kG with wave frequencies from 10^7 to 10^{15} c/s. C.G.Morgan

537.56

7113 **MEASUREMENT OF ELECTRON DENSITY IN AN EVOLVING PLASMA. EXPERIMENTAL ARRANGEMENTS.** T.Consoli and M.Dagai.

R. Acad. Sci. (Paris), Vol. 250, No. 7, 1223-5 (Feb. 15, 1960).
French.

See previous abstract. Gives block diagrams of apparatus used determine electron density in a magnetically confined plasma om measurements of the plane of rotation of a wave travelling rough the plasma. The density range is 10^{16} to 10^{20} electrons/m^3.
C.G.Morgan

537.56

7114 IMPULSE FROM AN EXPLODING WIRE PLASMA ACCELERATOR.
W.L.Starr.

. appl. Phys., Vol. 30, No. 4, 594-5 (April, 1959).

Ballistic pendulum measurements indicate impulses ~10^3 dyne/ ec, and streak camera photographs indicate velocities of 8×10^6 cm/sec for plasma magnetically produced by exploding to 8 mil dia. wire in a vacuum chamber at a pressure less than 0^{-5} mm Hg.
C.G.Morgan

537.56

7115 EXPERIMENTS WITH PLASMA RINGS.
L.Lindberg, E.Witalis and C.T.Jacobsen.

ature (London), Vol. 185, 452-3 (Feb. 13, 1960).

Presents measurements of transient magnetic flux carried by ring shaped plasma ejected from a coaxial plasma gun across tatic radial magnetic field.
C.G.Morgan

537.56

7116 EXCITATION OF PLASMA OSCILLATIONS.
P.A.Sturrock.

Phys. Rev., Vol. 117, No. 6, 1426-9 (March 15, 1960).

The theory of Bohm and Gross (Abstr. 5448-9 of 1949) and the experiments of Looney and Brown (Abstr. 4739 of 1954) upon the excitation of plasma oscillations by the two-stream mechanism, which appear superficially to be in disagreement, are shown to be compatible with each other and with related experiments.

537.56 : 538.56

REFLECTION OF ELECTROMAGNETIC WAVES FROM A LASMA. See Abstr. 5410

537.56

7117 ELECTRON ENERGY DISTRIBUTIONS IN PLASMAS. I
R.L.F.Boyd and N.D.Twiddy.

Proc. Roy. Soc. A, Vol. 250, 53-69 (Feb. 24, 1959).

The theory of the positive column is commonly based on the assumption of a Maxwellian energy distribution for the electrons, though in many cases it is far from clear how such a condition may be brought about. Moreover, past work has shown that the distribution is by no means always Maxwellian. Indeed, in any detailed consideration of the rates of inelastic collison processes occurring the the plasma it is desirable to be able to determine the distribution experimentally. A method of carrying out a Druyvesteyn analysis electronically is reported, and a critical account of its performance given. A high-frequency voltage of small amplitude chopped with a certain lower frequency is applied to a spherical probe, and the second derivative of the current-voltage characteristic is found from the amplitude of the sine wave with the chopping frequency present in the probe current. An adequate signal-to-noise ratio is obtained by using narrow band amplification with phase-sensitive detection. A large amount of data has now been obtained with this method in a variety of striated discharges. It is found that in every case studied so far the energy distribution takes the form of two well-separated groups of electrons with sometimes a very small third group. The high-energy group is generated by the potential difference across the striation head and becomes progressively attenuated towards its tail. An effect of the varying distribution is a sudden increase in the net rate of loss of electrons from the low-energy group resulting from the fall in number of electrons capable of ionizing and the change in potential difference between wall and discharge at the end of the striation. This loss of electrons causes a fall in the local discharge conductivity and so gives rise to another potential step and striation head.

537.56

7118 ION WAVE INSTABILITIES.
I.B.Bernstein, E.A.Frieman, R.M.Kulsrud and M.N.Rosenbluth.

Phys. of Fluids, Vol. 3, No. 1, 136-7 (Jan.-Feb., 1960).

The limited confinement time of plasma in the B-3 stellarator is explained in terms of the enhanced diffusion of ions across the magnetic field due to low frequency ion wave instabilities. It is shown that a minimum value of current is required for their onset.
A.H.Gabriel

537.56

7119 FLOW OF A PARTIALLY IONIZED GAS IN AN AXIAL MAGNETIC FIELD.
P.J.Dickerman and C.F.Price.

Phys. of Fluids, Vol. 3, No. 1, 137-8 (Jan.-Feb., 1960).

An experiment is described to study this configuration, by directing a stream of plasma from an air stabilized arc along the axis of a solenoid magnet. The rate of transfer of energy to the walls is measured.
A.H.Gabriel

537.56

7120 ABSORPTION COEFFIENTS FOR HIGH-TEMPERATURE NITROGEN, OXYGEN, AND AIR.
B.H.Armstrong and R.E.Meyerott.

Phys. of Fluids, Vol. 3, No. 1, 138-40 (Jan.-Feb., 1960).

This is essentially an abstract of two unpublished reports. Calculated Planck mean absorption coefficients and fractional populations of ionized species are shown in logarithmic plots against gas density at a temperature equivalent to 2 eV.
A.G.Gaydon

537.56

7121 CONFINEMENT OF CHARGED PARTICLES BY PLANE ELECTROMAGNETIC WAVES IN FREE SPACE.
C.M.Haaland.

Phys. Rev. Letters, Vol. 4, No. 3, 111-12 (Feb. 1, 1960).

A survey of the present position and possibilities in this field.
A.H.Gabriel

537.56

7122 STABLE CONFINEMENT OF HIGH-TEMPERATURE PLASMA.
R.F.Post, R.E.Ellis, F.C.Ford and M.N.Rosenbluth.

Phys. Rev. Letters, Vol. 4, No. 4, 166-70 (Feb. 15, 1960).

An experiment is described in which it is claimed that a plasma of particle density 10^{13} to 10^{14} cm^{-3} is confined in a Mirror Machine for times up to 30 msec. The electron temperature is of the order 10 to 25 keV, but measurements of ion temperature are inconclusive. These observations are contrary to the simple hydromagnetic theory which predicts rapid growth of "flute" instabilities. Measurements of the plasma expansion rate are consistent with classical diffusion theory, altough any intense plasma oscillations would be expected to increase the diffusion considerably. A number of possible explanations are suggested, the most probable of which is associated with the effect of intersection of the field lines with the metallized lining of the discharge tube.
A.H.Gabriel

537.56

7123 BUMPY TORUS.
G.Gibson, W.C.Jordan and E.J.Lauer.

Phys. Rev. Letters, Vol. 4, No. 5, 217-19 (March 1, 1960).

Considers particle drifts in a toroidal magnetic field with strong variations of the field strength around the torus. Presents results of machine calculations of single particle motion assuming constant kinetic energy and magnetic moment. All of the action integral curves have a minimum, and the precessional surface intercepts the symmetry plane of the torus at two values of radius. It is most unlikely that the precessional surfaces are not closed. Thus the imposed variations of the magnetic field may stabilize the toroidal drifts.
R.S.Pease

537.56

7124 STABILITY OF A LOW-PRESSURE PLASMA.
B.B.Kadomtsev.

Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1646-51 (Dec., 1959). In Russian.

A local stability condition for an arbitrary toroidal system is derived. The problem of stability of a low-pressure plasma in such systems is discussed.

537.56

7125 OSCILLATIONS OF AN ELECTRON—ION PLASMA.
L.M.Kovrizhnȳkh.

Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1692-6 (Dec., 1959). In Russian.

The spectrum of longitudinal oscillations of an electron—ion plasma is considered for the case of high temperatures (Maxwell distribution) and low temperatures (Fermi distribution). It is shown that, for small values of the wave vector k, the dispersion equation yields two branches which differ in their properties: an optical one for which the ion motion is not important and an acoustical one. For large values of k only the acoustical branch remains, its properties being determined by the parameters of the ion component of the plasma.

537.56

7126 STABILITY OF A PLANE POISEUILLE FLOW OF A PLASMA WITH FINITE CONDUCTIVITY IN A MAGNETIC FIELD. Yu.A.Tarasov.
Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1708-13 (Dec., 1959). In Russian.

The flow stability of a longitudinal plasma in a magnetic field with respect to infinitely small perturbations is considered for Reynolds numbers $R_m \leq 1$.

537.56

7127 CERTAIN PECULIARITIES OF JOULE HEATING OF THE ELECTRON GAS IN A PLASMA. A.V.Gurevich.
Zh. eksper. teor. Fiz., Vol. 38, No. 1, 116-21 (Jan., 1960). In Russian.

Electron gas heating in a plasma in a constant electric field was considered taking into account non-elastic electron collisions. It was found that the electron temperature can be stable only in weak electric fields with $E < E_k$; at $E \geq E_k$ this state is unstable. Dependence of E_k on plasma ionization was studied. Two modes of heating observed experimentally by Coor et al. and Bernstein et al. (1958) were interpreted and good agreement between theory and experiment was found.

537.56

7128 THE NON-LINEAR THEORY OF STEADY-STATE PROCESSES IN ELECTRON PLASMA. F.M.Nekrasov.
Zh. eksper. teor. Fiz., Vol. 38, No. 1, 233-8 (Jan., 1960). In Russian.

Non-linear problems of oscillation modes of electron plasma and interaction of plasma beams are considered on the basis of the kinetic equation without taking into account the collision integral. Relations between the wavelength and frequency and the oscillation amplitude are obtained. The maximum field in which periodic processes in plasma are possible is determined. Conditions for large-amplitude wave propagation are applicable to plasma at rest and plasma of moving beams.

537.56 : 536.7

7129 PLASMA CONSTITUTION, PLASMA DENSITY, ENTHALPY AND SPECIFIC HEAT OF OXYGEN AT 1, 3, 10, 30 ATM BETWEEN 1000 AND 30 000°K.
F. Burhorn and R.Wienecke.
Z. Phys. Chem. (Leipzig), Vol. 213, No. 1-2, 37-43 (1960). In German.

The formulae and methods of calculation of the physical quantities are briefly discussed. Calculated values for O_2 are tabulated at 1000°K intervals. S.Weintroub

ELECTRON EMISSION
ELECTRON BEAMS

537.533 : 539.1.07 : 621.387.424

THE WORK FUNCTION OF CATHODES AND THE PERFORMANCE CHARACTERISTICS OF GEIGER-MÜLLER TUBES.
See Abstr. 5438

537.533

7130 THE PROBLEM OF EXO-ELECTRON EMISSION PHENOMENA. B.Sujak.
Brit. J. appl. Phys., Vol. 10, No. 2, 102-3 (Feb., 1959).

Further to Grunberg's survey. See Abstr. 1722 of 1958.

537.533

7131 SHOT AND FLICKER NOISE ASSOCIATED WITH COLD ELECTRON EMISSION. C.Kleint and H.J.Gasse.
Z. Naturforsch, Vol. 15a, No. 1, 81-8 (Jan., 1960). In German.

Briefly describes measurements of the random emission of current in an electron field emission microscope. When the emitting tip is clean the noise spectrum is not frequency-dependent. When the emitting point is partly covered by adsorbed gas the noise spectrum increases in amplitude at lower frequencies. It is suggested that this flicker-type of noise arises from local moveme of adsorbed atoms and molecules on the surface of the point. T.Mulve

537.53

7132 EVAPORATION AND DIFFUSION RATE MEASUREMENTS ON CATHODES OF SINTERED NICKEL CONTAINING ALKALINE-EARTH OXIDES.
J.F.Richardson and F.A.Vick.
Brit. J. appl. Phys., Vol. 11, No. 2, 73-6 (Feb., 1960).

The evaporation rate of barium from a sintered nickel cathode and the diffusion rate of barium through it have been measured using Ba^{140} and tracer techniques. Confirmation of the evaporation rates thus determined have been obtained by comparison with measurements made by a method due to Becker. The activation energy of evaporation is 2.2 to 2.5 eV. Two diffusion processes operate, one predominant in the range 875 to 1020°C and one below 875°C. The activation energies are 2.5 and 0.5 eV respectively. The mechanism of diffusion at the higher temperatures appears to be Knudsen flow following evaporation from the inner surfaces, and that for the lower temperatures probably by surface diffusion.

537.533 : 621.385.032.213.1

7133 THE OXIDE CATHODE OF A SANDWICH STRUCTURE. S.Nakamura and E.Sugata.
Technol. Rep. Osaka Univ., Vol. 8, 261-71 (Oct., 1958).

Oxide cathodes with a sandwich structure, from which a stable emission current of large density in d.c. operation can be drawn, are described. The ordinary oxide-coated cathode is covered with a metal cap containing a hole or slit, and the gap between the base metal and its cap is filled up with the oxide materials, like a sandwich. Experimental results are presented. The operating mechanism is similar to that of "hollow cathodes". The beam drawn from the cathode slit (or hole) kept its sharp strip (or hollow) form in various operating conditions. Even if the activated cathode is ex posed to the atmosphere at room temperature, the emission curren recovers its initial value.

537.533 : 621.385.1.032.2

7134 THE GRID EMITTING PROPERTIES OF TITANIUM. J.A.Champion.
Brit. J. appl. Phys., Vol. 9, No. 12, 491-5 (Dec., 1958).

Experiments are described in which the emission from thin fil of barium and barium oxide deposited on titanium is compared with that from similar deposits on tungsten. With deposits of both bariu and barium oxide the emission from titanium is very much less tha that from tungsten throughout the temperature range investigated (700-1000°C). Above about 900°C the evaporation of titanium will poison the emission of an adjacent oxide cathode, but it is conclude that from 700°C up to this temperature titanium would possess goo grid emission suppression properties. This could enable titanium to be used as a screen-grid winding wire in the place of carbonized molybdenum wire in a number of receiving valves, and as an electrode material in other electronic devices where hot electrodes become contaminated with cathode material.

537.533 : 621.385.032.213.

7135 EVAPORATION OF THORIUM FROM CARBURIZED THORIATED TUNGSTEN CATHODES.
R.O.Jenkins and W.G.Trodden.
Brit. J. appl Phys., Vol. 10, No. 1, 10-15 (Jan., 1959).

The evaporation of thorium from carburized thoriated tungste cathodes is shown experimentally to be approximately the same as that from similar uncarburized cathodes at the same temperature. The thorium in a carburized cathode is, however, produced continuously at an adequate rate at the operating temperature of 2000°K by reduction of the thoria by the tungsten carbide. The uncarburiz cathode operates on a reserve of thorium built up by flashing at 2800°K at which temperature the tungsten reduces some of the thoria. These reactions have been examined by thermochemistry and it is shown that thorium diffuses to the surface of both types o cathode by a mechanism relatively insensitive to temperature.

537.533 : 621.385.1.032.

7136 THERMIONIC PROPERTIES OF THORIUM DEPOSITS ON CONTROL GRID MATERIALS. J.A.Champion.
Brit. J. appl. Phys., Vol. 10, No. 2, 71-4 (Feb., 1959).

Experiments are described in which the emission is measure from thin films of thorium deposited on different platinum—molybdenum phases of approximate composition Pt, Pt_3Mo, Pt_2Mo, Pt$_3$Mo$_2$ and Mo. The emission from all the platinum phases is considerably lower than that from pure molybdenum. The lowest emission was observed with the Pt$_3$Mo phase. The emission from thorium deposited on to the Pt$_3$Mo$_2$ phase decays rapidly at temperatures of 1300° C and above, whereas that from similar deposits on molybdenum does not. The emission from thin films of thorium deposited on to titanium and tungsten has also been studied. The emission from a layer on titanium that had been thoroughly pre-cleaned was found to be much less than that from a similar layer on tungsten. The application of these results to the suppression of grid emission in the presence of thoriated tungsten cathodes in transmitting valves is discussed.

537.533 : 621.385.2 : 621.362

7137 FIGURE OF MERIT FOR THERMIONIC ENERGY CONVERSION. N.S.Rasor.

J. appl. Phys., Vol. 31, No. 1, 163-7 (Jan., 1960).

See also Abstr 7073-5, 13371 (1959). The optimum performance for emission limited thermionic energy conversion is derived in convenient analytical form. The steps which are thereby indicated to reduce fundamental performance limitations are enumerated and briefly discussed. A figure of merit is defined with a brief description of its usefulness and significance. A comparison of thermionic and thermoelectric conversion is thereby afforded by the analysis.

537.533 : 621.315.59 : 621.385.032.213.73

7138 THE CONDUCTIVITY OF OXIDE CATHODES. PART 7. SOLID SEMICONDUCTION.

G.H.Metson and E.Macartney.

Proc. Instn Elect. Engrs, Monogr. 374 E, publ. Oct., 1959 (Vol. 107C, 91-7).

Republication of the monograph abstracted in Abstr. 263 (1960).

537.533

7139 EMISSION CHARACTERISTICS OF GERMANIUM TREATED WITH CAESIUM VAPOURS. V.G.Bol'Shov, L.N.Dobretsov, A.A.Zharinov,A.A., T.V.Krachino and M.K.Repnikova.

Fiz. tverdogo Tela, Vol. 1, No. 11, 1768-70 (Nov., 1959). In Russian.

Thermionic, photo-, and secondary electron emission from n-type Ge single crystals and vacuum-deposited films was studied before and after treatment with caesium vapours. Both the electrical conductivity and the secondary emission coefficient of the investigated specimens were increased by a factor of about 2 after the caesium treatment. M.H.Sloboda

537.333

7140 STUDIES OF SPECIFIC CHARACTERISTICS OF PHOTOMULTIPLIERS. P.Cachon.

C.R. Acad. Sci. (Paris), Vol. 250, No. 6, 1004-6 (Feb. 8, 1960). In French.

537.533

7141 A NEW METHOD FOR THE STUDY OF THE SPECTRAL DISTRIBUTION OF PHOTOELECTRIC EMISSION.

P.Vernier and P.Hartmann.

C.R. Acad. Sci. (Paris), Vol. 250, No. 6, 1019-21 (Feb. 8, 1960). In French.

A Lallemand electronic camera can be used as a very sensitive detector of the emitted electrons, The normal Lallemand camera has a Cs—Sb photocathode, and the electrons emitted when light is incident are accelerated and focussed on to a photographic plate. Here the solid under study is used as the cathode, and a spectrum of known intensity distribution is cast across it. Results are given for the photoemission of fused quartz. C.Hilsum

537.533

7142 AN IMAGE INTENSIFIER WITH TRANSMITTED SECONDARY ELECTRON MULTIPLICATION.

W.L.Wilcock, D.L.Emberson and B.Weekley.

Nature (London), Vol. 185, 370-1 (Feb. 6, 1960).

The construction of image intensifying tubes using an Sb—Cs photocathode and a set of thin-film KC1 dynodes for electron multiplication by transmitted secondary emission is described. Details of operating conditions and performance are given.

C.H.B.Mee

537.533

7143 OPTIMUM CONDITIONS FOR PHOTOMULTIPLIERS FÉU-13. A.N.Pisarevskii and L.D.Soshin.

Pribory i Tekh. Eksper., 1959, No. 3, 143 (May-June). In Russian.

The potential on the "modulator" (grid) in photomultiplier type FÉU-13 has great influence on the collection of photoelectrons, hence on the amplitude resolution. It was found that for optimum resolution the collection of electrons is maximum, and this occurred when the potential differences between the photocathode and grid and between the grid and first dynode, were in the ratio 2:1.

J.M.Zarzycki

537.533 : 621.383.27

7144 RESISTANCE STRIP MAGNETIC PHOTOMULTIPLIER FOR THE EXTREME ULTRAVIOLET.

L.Heroux and H.E.Hinteregger.

Rev. sci. Instrum., Vol. 31, No. 3, 280-6 (March, 1960).

The performance of a windowless resistance strip magnetic multiplier for detection of extreme ultraviolet is described. The detector is characterized by a high spectral sensitivity for wavelengths below 1400 A and a low sensitivity to longer wavelength radiation. It is reproducible in spectral response and gain after exposure to air or after cleaning. A current gain of 10^8 can be realized with the multiplier for an over-all voltage of approximately 2000 V. The photomultiplier can be operated as a photoelectron counter with a well-defined counting plateau for pressures below 10^{-4} mm Hg. The background counting rate of the detector, at room temperature and typical operation in the plateau region, is less than 0.1 count/sec.

537.533

7145 INVESTIGATION OF THE SECONDARY ELECTRON EMISSION FROM SOME DIELECTRICS IN THE REGION OF LOW PRIMARY ENERGIES. S.A.Fridrikhov and A.R.Shul'man.

Fiz. tverdogo Tela, Vol. 1, No. 8, 1259-67 (Aug., 1959). In Russian.

Secondary electron emission from glass, mica, alundum*, fluorite, willemite and stibnite, bombarded with electrons of low (up to 50 V) energy, V_p, was studied. The magnitude, V_p^I, of the first critical potentials (i.e. potentials at which the coeff. of secondary electron emission, σ, for the first time became unity) was determined, and it was found that V_p^I was not dependent on temperature. In the very low (2-3 V) V_p range, the coeff. of elastic electron reflection, R, attained the comparatively high value of 0.6-0.7 in all the studied substances; this effect was attributed to quasi-elastic dissipation of the primary electrons on phonons. While the $R = R(V_p)$ curves were similar for all the investigated substances, no such similarity was observed in the case of the $\sigma = f(V_p)$ curves.

[*alundum = fused bauxite or alumina.] M.H.Sloboda

537.533

7146 INELASTIC SCATTERING OF ELECTRONS AND SECONDARY ELECTRON EMISSION OF CERTAIN METALS. I. I.M.Bronstein and R.B.Segal'.

Fiz. tverdogo Tela, Vol. 1, No. 10, 1489-99 (Oct., 1959). In Russian.

Secondary electrons ejected from targets by primary electron bombardment are usually accompanied by inelastically scattered primary electrons, and by the secondaries produced by these. The components can be separated by depositing on the target various thicknesses of a material having a much greater coefficient of inelastic scattering than that of the target ("mirror" method). Curves relating emission to incident energy can be drawn for each thickness, and from these the relative significance of genuine secondary emission and inelastically scattered primaries can be deduced.

A.E.I.Research Laboratory

537.533

7147 INELASTIC SCATTERING OF ELECTRONS AND SECONDARY ELECTRON EMISSION OF CERTAIN METALS. II. I.M.Bronstein and R.B.Segal'.

Fiz. tverdogo Tela, Vol. 1, No. 10, 1500-8 (Oct., 1959). In Russian.

The relative significance of genuine secondary electron emission and inelastic scattering (see preceding abstract) may also be determined by depositing on the target various thicknesses of a material having a much smaller coefficient of inelastic scattering than that of the target, and also by depositing layers having an inelastic scattering coefficient similar to that of the target, but differing from it in secondary emission coefficient ("null" and "equivalent" methods respectively). Application of these methods confirm the results of the previous abstract.

A.E.I.Research Laboratory

537.533

7148 SECONDARY ELECTRON EMISSION OF THIN METAL LAYERS ON AN ACTIVATING UNDER-LAYER.

I.M.Bronshtein and R.B.Segal'.

Fiz. tverdogo Tela, Vol. 2, No. 1, 93-5 (Jan., 1960). In Russian.

Following previous work (see Abstr. 12360 of 1959) in which the predominant rôle of the inelastic scattering coefficient in secondary electron emission was established, measured values of this coefficient and of the second emission coefficient are shown plotted against the energy of the exciting electron beam. Reasons are suggested for the characteristic form of these curves.

A.E.I. Research Laboratory

537.533

7149 VARIATION OF SECONDARY ELECTRON EMISSION OF SINGLE CRYSTALS WITH ANGLE OF INCIDENCE.

A.J.Dekker.

Phys. Rev. Letters, Vol. 4, No. 2, 55-7 (Jan. 15, 1960).

It is suggested that the observed dependence of the intensity of secondary electron emission upon the angle of the incident primary beam (Abstr. 1154 of 1960) is best explained in terms of the diffraction of the primary beam. C.G.Morgan

537.533

7150 THE INFLUENCE OF ROLLING TEXTURE ON THE ELECTRON EMISSION OF COLD PURE METAL CATHODES. G.Purt.

Z. angew. Phys., Vol. 12, No. 3, 117-20 (March, 1960). In German.

Describes an indirect method for measuring the electron yield per incident ion for a cold metal cathode. Molybdenum sheets showing various rolling textures were used as cathodes in gas discharge tubes, and the cathode drop was measured. This quantity is related to the electron yield and was found to vary with rolling texture of the sheet. As a by-product of this work improvements have been made in the reproducibility of gas stabilizer tubes by controlling the texture of the molybdenum cathodes. T.Mulvey

537.533

7151 ANODE SURFACE EFFECTS IN DIODES CONTAINING OXIDE-COATED CATHODES. B.J.Hopkins.

Brit J. appl. Phys., Vol. 11, No. 3, 124-8 (March, 1960).

Two types of experimental tube have been built to study the behaviour of thin films deposited on the anode by evaporation during the breakdown and activation of calcium and barium oxide coated cathodes. First, with diodes of cylindrical symmetry, a contact-potential-difference method has been used to follow the changes in anode work function during activation of the cathode at several anode potentials. Emission-poisoning effects have been related to changes in the anode work function and it appears that there are two separate contaminating films on the anode surface: a very tightly held electropositive layer and a loosely bound electronegative layer. The emission decay process by the decomposition of compounds on the anode does not explain the results adequately. The second tube contained a movable glass electrode upon which a gold film could be deposited by evaporation. The results from these tubes confirmed those from the cylindrical diodes and also the validity of the contact-potential-difference method.

537.533

7152 POTENTIAL DISTRIBUTION BETWEEN TWO PLANE EMITTING ELECTRODES.

P.A.Lindsay and F.W.Parker.

J.Electronics and Control, Vol. 7, No. 4, 289-315 (Oct., 1959).

The derivation of expressions is given for the space charge and potential distribution between two plane parallel emitting electrodes. Numerical calculations are carried out for the case when an external potential difference ϕ_{ext} is applied between the electrodes, both being at the same temperature T. It is shown that all possible potential distributions can be represented by a single family of curves, the parameter of the family being $A = \exp(-e\phi_{ext}/kT)$. Thus for a given ϕ_{ext} the same general curve of potential distribution applies, whatever the values of the electrode work functions. Changing the work functions merely shifts the end points of the potential distribution along the curve.

537.533 : 611.387

7153 DEUTERIUM-FILLED THYRATRONS.

K.G.Cook and G.G.Isaacs. DEUTERIUM AS A FILLING FOR HIGH-VOLTAGE THYRATRONS. R.J.Armstrong and N.S.Nicholls.

Brit. J. appl. Phys., Vol. 9, No. 12, 497-8, 498-9 (Dec., 1958).

537.533 : 621.385.833

7154 THE RELATIONS FOR CONSTANT CURRENT IN MULTI-BEAM ONE-DIMENSIONAL ELECTRON STREAMS.

Chzhan Dzhi-Min [Chang Chih-Ming].

Zh. tekh. Fiz., Vol. 29, No. 2, 163-9 (Feb., 1959). In Russian. English translation in: Soviet Physics—Technical Physics (New Yo Vol. 4, No. 2, 140-5 (Feb., 1959).

Considers the one-dimensional flow of n intermingled beams which pass through two infinite planes on which the potential has fixed values. The relations for single beams are generalized to two-beam streams.

537.5

7155 SCATTERING OF A LONGITUDINALLY POLARISED ELECTRON BEAM BY A UNIFORM MAGNETIC FIEL

H.Banerjee.

Proc. Nat. Inst. Sci. India A, Vol. 24, No. 5, 279-87 (1958).

Polarization effects of the scattering of longitudinally polarize electron beam by a uniform magnetic field has been considered. I evaluating the differential cross-section for the scattering process the S-matrix formalism of Feynman and Dyson has been followed. Detailed analysis of the results has been given for two special cas viz. (1) when the magnetic field is longitudinal and (2) when it is transverse with respect to the momentum of the incident beam. Finally, it has been shown that the magnetic moment of a free elec tron could be determined by detecting the polarization of the scattered beam by an analyser.

537.5

7156 METHOD OF CALCULATING THE FLUX DENSITY A ITS DERIVATIVES ON THE AXIS OF A MAGNETIC ELECTRON LENS WITH AXIAL SYMMETRY. M.Laudet.

J. Phys. Radium, Vol. 18, Suppl. No. 7, 73A-77A (July, 1957). In French.

It is shown how it is possible to calculate the values of the flu density B and of its derivatives B' and B'',... on the axis of a magnetic electron lens with rotational symmetry after measuring the flux density with simple matrix products. The numerical values a then given for the "elementary matrices" and the method is appli to the case of a circular current whose mathematical expressions of the flux density and its derivatives are already known. In this way, a precise idea of the accuracy of the results is obtained. Finally, stress is laid on the practical interest of this method whic allows measurement of B, B' and B'' with one search coil having only one winding, the diameter of which is limited only by that of t bore of the pole pieces of the lens used.

537.5

7157 AN APPROXIMATE LENS FOR HIGH ENERGY PARTICLES. D.Luckey.

Rev. sci. Instrum., Vol. 31, No. 2. 202-3 (Feb., 1960).

A magnetic lens was constructed by arranging 19 conductors i hexagonal array parallel to the optic axis. The length of the lens was 1 m., the outside diameter 25 cm and the focal length for 100 MeV electrons was about 1 m when the current through the co ductors was 500 amp. The focal length is not very sharply defined the transparency of the lens is about 80-90% and the image of a 2 i dia. source was 3 in. × 4 in. Compared with a standard quadrupol the new lens uses no iron and requires less stored energy for give focal power, but the focusing is less perfect and the transparency less. V.E.Cossl

537.5

7158 ACCURACY OF SELECTED-AREA MICRODIFFRACT IN THE ELECTRON MICROSCOPE. A.W.Agar.

Brit. J. appl. Phys., Vol. 11, No. 5, 185-9 (May, 1960).

Because of the spherical aberration at the objective lens, the area of an object defined by the selector aperture for microdiffraction experiments does not exactly correspond to the actual par of the specimen contributing to the pattern. Further errors may arise through incorrect lens settings. The magnitude of the possi errors and the electron-optical explanation are discussed. The th retical results are in reasonable agreement with the experimental observed errors. It is concluded that especial care is required in studies of thin metal foils where misorientations between grains a being measured.

537.533 : 621.385.8

7159 RESISTANCE BIAS CHARACTERISTIC OF THE ELECTRON MICROSCOPE GUN.

M.E.Haine, P.A.Einstein and P.H.Borcherds.

Brit. J. appl. Phys., Vol. 9, No. 12, 482-6 (Dec., 1958).

It has been shown in a previous paper (Abstr. 2800 of 1952) that the theoretical value of current density per unit solid angle (brightness) could be obtained from the hairpin cathode electron microscope gun for a wide range of geometrical design, provided that an optimum bias voltage, which depended on the geometrical design, was applied between shield and cathode. When using a self-biasing arrangement, the total beam current tends to become stabilized by negative feed-back action. This is a valuable advantage but may lead to the impossibility of operating the gun at the optimum bias voltage. The present investigation shows that for a reasonably wide range of geometrical design, conditions can be established, with the correct choice of bias resistance, whereby the gun can be operated at theoretical brightness and with current stabilization, for a reasonable choice of filament temperature, giving a range for choice in beam angle or beam control.

537.533

7160 DEFOCUSING CONTRAST IN COHERENT ILLUMINATION, IN THE CASE OF A PERIODIC OBJECT IN THE ELECTRON MICROSCOPE.

M.Fagot and C.Fert.

C. R. Acad. Sci (Paris), Vol. 250, No. 1, 94-6 (Jan. 4, 1960). In French.

The variation in image contrast on departure from focus has been followed, using as object in the electron microscope a biological section containing dense particles arranged in two-dimensional array. The phenomena observed in coherent illumination are directly analogous to what is seen in an optical microscope. In particular, the contrast reverses for an amount of defocusing equal to $0.75x^2/\lambda$, where x is the periodicity of the object and λ the wavelength of the illuminating beam and a "true" image is obtained again at twice this amount of defocusing. This repeat distance was $26\ \mu$ in the electron microscope and 23 mm in an experiment carried out in visible light on a dot pattern in order to check the optical theory.

V.E.Cosslett

537.533 : 539.1.07

7161 DESIGN OF CONTINUOUS BAFFLE IN A SHORT LENS BETA-RAY SPECTROMETER.

P.N.Mukherjee, M.K.Pal, M.K.Banerjee and A.K.Saha.

Indian J. Phys., Vol. 31, No. 10, 531-8 (Oct., 1957).

The spectrometer can measure up to 4 MeV electrons. The performance of the spectrometer is checked up using a Cs^{137} source. A new and simple method of alignment of the spectrometer is proposed. Ring focusing is investigated by photographic method, and from the observed nature of the caustic envelope of the electron trajectories a continuous baffle is designed. With this new baffle system a resolution of 1.47% at a transmissions of 0.56% is obtained.

537.533

7162 THEORY OF A HIGH-RESOLUTION BETA-RAY SPECTROMETER WITH HIGH LUMINOSITY.

H.Daniel.

Rev. sci. Instrum., Vol. 31, No. 3, 249-52 (March, 1960).

Second-order perturbation theory was used to calculate the electron orbits in a "flat" beta-ray spectrometer with an azimuth-independent magnetic field having a symmetry plane. Abandoning first-order z focusing, it is possible to obtain a much higher resolution at a given transmission compared with the usual $\pi\sqrt{2}$ instrument. The resolution depends, in the lowest power, only on fourth-order terms of the radial and axial emission angles. The resolution does not depend on the first power of the source height. The focusing principle is applicable for a set of angles θ, and the dispersion increases strongly with increasing angle. Several examples are discussed.

537.533

7163 INVESTIGATION OF THE PASSAGE OF ELECTRONS WITH ENERGIES FROM 0.5 TO 16 keV THROUGH COLLODION AND GOLD FILMS.

I.R.Kanicheva and V.A.Burtsev.

Fiz. tverdogo Tela, Vol. 1, No. 8, 1250-8 (Aug., 1959). In Russian.

In both gold and collodion films the relation between penetration and energy of the electrons was found to obey Bethe's theory. The electrons emerging from the films could be divided into two groups (slow: 0-150 eV; fast: 150 eV upwards) obeying different laws of deceleration, the loss of energy per unit length being constant in the case of the fast group. The slow group constituted a significant part of the total.

A.E.I. Research Laboratory

ION EMISSION . ION BEAMS

537.534

7164 AIR IONS PRODUCED BY A TRITIUM-ION GENERATOR. I. ION GENERATORS.

R.Siksna and R.Lindsay.

Ark. Geofys., Vol. 3, Paper 8, 123-39 (1959).

Different arrangements of a tritium-ion source as a generator of air ions have been tried with the intention of finding effective combinations of separating field and airflow to obtain high concentrations of desired-polarity ions. The effectiveness of separating the ions is demonstrated by separation characteristics in which the number of ions of the desired polarity and of the undesired polarity is plotted (dependence on the applied electric field and on the airflow through the generator being shown). With appropriate constructions concentrations up to 5 million ions per cm^3 are obtained corresponding to a production of approximately 2×10^9 ions per sec. Possibilities to increase the effectiveness of the tritium-ion generator are discussed. The problem of producing air ions of desired polarity in sufficiently high concentrations and without any admixture confronts investigators of the influences of air ions on biological processes. Moreover, an appropriate source of air ions is also of great importance as a tool for investigating these ions from a general physical point of view.

537.534

7165 AIR IONS PRODUCED BY A TRITIUM-ION GENERATOR. II. MEASUREMENT OF IONS IN A ROOM. MOBILITY.

R.Siksna and R.Lindsay.

Ark. Geofys., Vol. 3, Paper 9, 141-54 (1959).

The ionic content of a room in which is placed a tritium-ion generator has been investigated. The ions emerging from the generator are introduced into the room in a beam of varying concentration, and ionization is not uniformly distributed throughout the room. When high ion concentrations exist, the measurement problem is complicated by the presence of highly charged dust particles. Data indicate three distinct mobility groups for the positive air ions; 2-2.5, 0.8-1, and 0.4 $cm^2\ sec^{-1}\ volt^{-1}$. The distribution of negative air ions with respect to mobility appears to be a continuous function — indicating, perhaps, a difference in physical properties between positive and negative ions.

537.534 : 539.2

THERMIONIC AND ACTIVATED THERMIONIC EMISSION OF IMPURITY IONS FROM A Pt SURFACE. See Abstr. 6061

537.534 : 539.2 : 537.311

7166 MEASUREMENT OF ION BEAM CURRENTS USING A HALL EFFECT MAGNETOMETER.

W.S.Whitlock and C. Hilsum.

Nature (London), Vol. 185, 302 (Jan. 30, 1960).

The magnetic field associated with the beam is collected by a surrounding magnetic core, and applied to an indium antimonide Hall effect unit which is in an air gap in the core. The unit can measure magnetic fields of less than 10^{-3}Oe, when used in conjunction with a transistor oscillator and amplifier. Currents down to $10\mu A$ were measured.

C.Hilsum

537.534

7167 A TECHNIQUE FOR INVESTIGATING SECONDARY PROCESSES CAUSED BY IONS AT A HIGH-TEMPERATURE TARGET IN THE PRESENCE OF THERMIONIC EMISSION.

U.A.Arifov, A.Kh.Ayukhanov, S.V.Stardubtsev and Kh.Kh.Khadzhimukhamedov.

Dokl. Akad. Nauk SSSR Vol. 124, No. 1, 60-2 (1959). In Russian.

Uses a method of double modulation (Abstr. 1923 of 1955). The investigation was at high temperatures at which thermoionic emission takes place and at which there is the possibility of controlling the work function of the target. The method allows the separate investigation of the components of secondary emission. See also Abstr. 5062 (1958).

J.M.Zarzycki

537.534

7168 SHIFT OF THE FOCAL SPOT OF A PARAXIAL ION BEAM DUE TO THE EFFECT OF SPACE CHARGE IN THE REGION OF THE LENS.

N.Pucker.

Acta Phys. Austriaca, Vol. 13, No. 1, 65-75 (1960). In German.

Continuing a previous investigation (Abstr. 277 of 1960), the effect of space charge is calculated for an ion beam focused by a two-tube lens carrying voltages V_0 and hV_0. The axial shift in the focal points is evaluated for a range of values of h, within a certain range of values of V_0 and current density j_0. Only within a narrow range of h is a true focal spot formed. V.E.Cosslett

537.534

7169

UTILIZATION OF SECONDARY ELECTRONS TO IMPROVE THE EXTRACTION AND FOCUSING OF A BEAM OF LI^+ IONS EMANATING FROM A SOLID SOURCE.

J.P.Poffe.

C.R. Acad. Sci. (Paris), Vol. 249, No. 23, 2520-2 (Dec. 9, 1959). In French.

Briefly describes an electrode system capable of controlling the secondary emission current from a target bombarded by Li^+ ions produced by a emitter which is heated by electron bombardment. By directing the fast secondary electrons back to the emitting surface, space-charge effects there are reduced and beam focusing is improved. A.E.I. Research Laboratory

537.534

7170

IMPROVED TRANSMISSION OF IONS WITH INHOMOGENEOUS MAGNETIC FIELDS.

S.B.Karmohapatro.

Indian J. Phys., Vol. 32, No. 1, 26-34 (Jan., 1958).

Design parameters for symmetrical and asymmetrical first order focusing conical shaped inhomogeneous magnetic analysers with field varying as r^{-n} where $0.5 < n < 1$ are considered for utilizing their high resolving power with improvements in transmission of ions. Some representative cases for such a 180°-magnetic analyser are shown with a discussion for using such magnets with different sector angles in mass spectroscopy, which will be more advantageous than the conventional flat type homogeneous magnetic analysers, when solid angle and resolving power of the instruments are simultaneously considered.

537.534 : 539.17 : 621.039

TRAPPING FAST CHARGED PARTICLES IN A MAGNETIC FIELD. STUDIES ON O.G.R.A. See Abstr. 5840

537.534

7171

APPARATUS DRAWINGS PROJECT. REPORT NUMBER 7. VERSATILE MASS SPECTROMETER.

R.G.Marcley.

Amer. J. Phys., Vol. 28, No. 5, 418-24 (May, 1960).

An extremely versatile mass spectrometer, suitable for an undergraduate laboratory and simple enough to be constructed by an average departmental shop, is described. The data obtained when using the potassium isotopes K^{41} and K^{39} indicate an instrument resolving power of 75. The auxiliary equipment required is conventional and inexpensive. The apparatus structure and construction techniques are described in detail.

537.534

7172

UNDERGRADUATE MASS SPECTROMETER.

J.W.Dewdney.

Amer. J. Phys., Vol. 28, No. 5, 452-6 (May, 1960).

Described here is a simple static-field mass spectrometer which has had usefulness both as an undergraduate laboratory instrument and as a piece of demonstration apparatus. The design provides for the adjustment of such parameters as magnet position, slit widths and heights, and allows the use of different types of sources and detectors. Ion currents are large enough to be easily measured or displayed on an oscilloscope.

537.534

7173

INTENSITY DISTRIBUTION ALONG THE 'LINE' OF A 180° MAGNETIC SPECTROMETER.

E.Keberlé.

J. Rech. Cent. Nat. Rech. Sci., No. 49, 283-8 (Dec., 1959). In French.

A geometrical construction is given for finding the paths of α-particles or electrons through a 180° magnetic spectrometer. The important geometrical parameters are related, after suitable transformations, to the co-ordinates of a certain ellipse. This enables the electron trajectories to be drawn and the distribution of intensity in the line focus to be determined. A.E.I. Research Laboratory

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PARTICLE ACCELERATORS

537.54

7174

CALCULATION OF TRAJECTORIES OF RELATIVISTIC CHARGED PARTICLES IN ELECTRIC AND MAGNETIC FIELDS BY THE ADAMS' METHOD OF FINITE DIFFERENCES.

N.I.Shtepa.

Zh. tekh. Fiz., Vol. 29, No. 1, 120-7 (Jan., 1959). In Russian. English translation in: Soviet Physics—Technical Physics (New York), Vol. 4, No. 1, 105-12 (Jan., 1959).

The Adams' extrapolation method of finite differences is used. One considers the cases of superposed constant and time-dependent electric fields and constant magnetic fields of arbitrary shape, the case of such fields with the addition of a time-dependent axially symmetrical magnetic field, and the case of axially symmetrical constant and variable electric and magnetic fields. Methods for estimating the error are given. An example is presented.

537.54

7175

CONTROL AND CALIBRATION OF THE BETATRON ENERGY SCALE.

K.N.Geller and E.G.Muirhead.

Rev. sci. Instrum., Vol. 31, No. 3, 308-13 (March, 1960).

A new system for control of the X-ray energy from a 25 MeV betatron is described. Modifications in the method of energy control and orbit expansion lead to improved operation. Calibration of the energy scale is based on reaction thresholds for $D(\gamma,n)$, $Bi^{209}(\gamma,n)$, $Cu^{63}(\gamma,n)$, and the threshold for excitation of the 15.116 MeV state in C^{12}. The resulting energy scale is linear with respect to electron momentum to better than ±20 keV.

537.54

7176

TABLES OF ENERGY VERSUS MAGNETIC FIELD STRENGTH FOR He^3.

A.Barragán and J.Solt.

Rev. Mexicana Fis., Vol. 8, No. 3, 229-42 (1959). In Spanish.

Tables of He^3 energies (keV) versus magnetic field strength times orbit radius are given in the range 50 to 1050 kG cm.

537.54

7177

PHASE RELATIONSHIPS IN THE CYCLOTRON.

N.D.Fedorov.

J. nuclear Energy, Vol. 6, No. 3, 255-7 (1958). English translation of article in: Atomnaya Energiya, Vol. 2, 385 (1957).

537.54

7178

THEORETICAL ASPECTS OF THE SOVIET 10 GeV SYNCHROTRON.

M.S.Rabinovich.

J. nuclear Energy, Vol. 6, No. 4, 351-69 (May, 1958). English trans lation of article in: Atomnaya Energiya, Vol. 2, 431 (1957).

Methods are developed for analysing the behaviour of weak-focusing synchrotrons and, in particular, for calculating design para meters. Free oscillations, orbit distortions, resonances in free and phase oscillations, and injection, are considered. The theory is applied to the 10 GeV synchrotron of the U.S.S.R. Academy of Sciences.

537.5

7179

THE CERN PROTON SYNCHROTRON.

J.B.Adams.

Nature (London), Vol. 185, 568-72 (Feb. 27, 1960).

The sequence of events leading to the decision to build the 25 Ge A.G.S. is described. The explanation of the alternating gradient principle is given; its advantages and attendant difficulties are discussed. Figures are given to indicate the performance to date and t compare it with that of other GeV accelerators in use or under construction. Costs are compared for the European accelerators in the GeV range. A.Ashmore

537.5

7180

MEASUREMENTS OF THE RADIAL PHASE AMPLITUD DISTRIBUTIONS OF PARTICLES.

K.A.Belovintsev and B.N.Yablokov.

Pribory i Tekh. Eksper., 1959, No. 2, 12-15 (March-April). In Russian.

Gives the mathematical basis and description of gamma distribution measurements made with a 280 MeV synchrotron. The intensity distribution in the extended gamma pulse was measured with a single-channel time analyser (see following abstract), and the resonator voltage by a pulse voltmeter, the circuit of which is shown. Illustrations also include typical intensity distributions as functions of the radial phase amplitudes and angular bunch half-width as a function of starting time of the r.f. voltage pulse (pulse amplitude, 1200 V). D.E.Brown

537.54

7181 A MEASURING DEVICE FOR THE INTENSITY DISTRIBUTION IN A SYNCHROTRON EXTENDED GAMMA PULSE. K.A.Belovintsev, O.A.Karpukhin, A.V.Kutsenko, A.A.Shapkin and B.N.Yablokov.

Pribory i Tekh. Eksper., 1959, No. 2, 15-18 (March-April). In Russian.

Describes, with circuit diagrams, a single-channel time analyser for a 280 MeV synchrotron, the principle being to pass all the gamma pulses periodically through the analyser "window", record part of the pulse, and relate the part recorded to the total pulse intensity. The photomultiplier pulse obtained in accordance with this principle passes to two channels, an integrator (or monitor) and a differentiator. The time selection pulse is positioned by a delay circuit triggered from the synchrotron equipment. The automatic control circuit incorporated in the device is based on an automatic telephone step-by-step switch. D.E.Brown

MAGNETISM

(The magnetic properties of solids are included under Solid-State Physics; similarly for Liquid State and Gaseous State)

538 : 621.317.44

7182 DESIGN OF A MAGNETOMETER AND OF A MAGNETIC FIELD-GRADIENT METER. M.Spighel.

J. Phys. Radium, Vol. 18, Suppl. No. 7, 108A-111A (July,1957). In French.

A magnetometer with an oscillating rotative coil and a linearly vibrating coil, for use in a spectrograph, is described. In order to allow a null method, a reference alternating potential, with phase and frequency identical to the signal induced in the coils, is produced by an oscillating capacitor mounted on the same axis as the coils. The measurement is thus independent of frequency and amplitude because the two opposite potentials are both proportional to this frequency and amplitude. The measurement of a point field requires the knowledge of the successive derivatives of $(\partial^n H)/(\partial x^n)$. The geometrical characteristics of the coils is such that all derivatives up to $(\partial^3 H)/(\partial x^3)$ inclusive are null. Even in an inhomogenous field the best conditions are approached for the measurement of a point magnetic field.

538 : 621.317.44

7183 AN ELECTRONIC FLUXMETER. R.R.Birss and J.P.Fry.

J. sci. Instrum., Vol. 37, No. 1, 31-2 (Jan., 1960).

It possesses a number of advantages over a conventional fluxmeter. It has four operating ranges and may be used with search coil of high resistance. Provision is made for self-calibration of both the sensitivity and the linearity of the instrument. The fluxmeter is suitable for operation by a non-scientist.

538 : 621.317.44

7184 MULTIPLE-ELEMENT HALL-EFFECT SENSOR. M.Epstein, H.M.Sachs and L.J.Greenstein.

Proc. Inst. Radio Engrs, Vol. 47, No. 11, 2014 (Nov., 1959).

For a given heat dissipation per unit area, the sensitivity is proportional to the width of the Hall-effect sensor. A multiple-element sensor gives increased width without increased area, which would make the device less effective for measurements at a point. The four-element sensor described produced 240 μV output for a field of 8 Oe. R.C.Kell

538 : 539.2 : 537.311

INDIUM ARSENIDE HALL-EFFECT PROBES FOR MEASURING THE MAGNETIC FIELD INTENSITY. See Abstr. 6123

538

7185 SUSCEPTIBILITY SERVO-BALANCE FOR MEASUREMENTS ON METALS OF EXTREMELY LOW RESISTIVITIES. F.T.Hedgcock and W.B.Muir.

Rev. sci. Instrum., Vol. 31, No. 4, 390-4 (April, 1960).

Although a great variety of methods have already been described for measuring magnetic susceptibility, the present instrument has the advantage that it makes possible measurements on weakly magnetic high-purity metals having extremely small resistivities. Most servo-balances for measuring susceptibility that have been described in the literature have been for strong paramagnetics or ferromagnetics and in none of the balances has the effect due to strong induced eddy currents been allowed for. The present instrument consists of a sensitive electrodynamic balance which is operated as a null instrument by allowing it to form part of a servomechanical network. The feedback system provides a stiffness of balance movement of $8 \times \times 10^4$ d/deg deflection. The sensitivity of this instrument is such that changes of 10^{-9} e.m.u./g may be detected in the susceptibility of large metallic samples having electrical resistances less than 10^{-8} ohm cm.

538

7186 SIMPLE NULL-INDICATING SATURABLE-CORE MAGNETOMETER FOR THE DETECTION OF STATIC MAGNETIC FIELDS. E.P.McCurley and C.Blake.

Rev. sci. Instrum., Vol. 31, No. 4, 440-3 (April, 1960).

A simple null-indicating saturable-core magnetometer has been designed as a completely self-contained unit requiring no associated equipment other than a VTVM or oscilloscope for monitoring the output. The device is useful for detecting static magnetic fields of the order of 0.1 mOe. It was built to enable the establishment of a near zero magnetic field over a limited volume by means of pairs of Helmholtz coils. A Hartshorn bridge circuit is employed to cancel out the fundamental of the driving frequency in the output portion of the circuit. A test signal incorporated into the instrument affords a check on the sensitivity.

538

7187 A SENSITIVE MAGNETIC BALANCE FOR THE DETERMINATION OF SMALL SUSCEPTIBILITY DIFFERENCES. D.Geist.

Z. Phys., Vol. 158, No. 3, 359 66 (1960). In German.

For a determination of the carrier susceptibility in a semi conductor sample it is necessary to measure the susceptibility difference between different doped samples. A susceptibility balance (torsion pendulum) is described for difference measurements between 140^0 and 300^0K in vacuo. A permanent magnet with a cylindrical yoke is used. The achievable accuracy of the susceptibility difference amounts to ±0.03% of the whole susceptibility. The smallest detectable difference in mass susceptibility is $\Delta\chi = 3 \times 10^{-11}$ cgs$_m$ (corresponding to a paramagnetism of 3×10^{15} electron spins at 140^0K).

538 : 681.142

7188 SUMMARIZED PROCEEDINGS OF A CONFERENCE ON SOLID STATE MEMORY AND SWITCHING DEVICES — LONDON, SEPTEMBER, 1958. T.B.Rymer.

Brit. J. appl. Phys., Vol. 10, No. 4, 153-8 (April, 1959).

538

7189 CONTRIBUTION TO THE STUDY OF THE REVERSAL OF A FERROMAGNETIC CORE UNDER THE ACTION OF A CONSTANT CURRENT SOURCE. C.Durante and J.Lailheugue.

C.R. Acad. Sci. (Paris), Vol. 249, No. 9, 917-8 (Aug. 31, 1959). In French.

An extension of previous work (see Abstr. 11206 of 1959). Expressions for the reversal time and the dynamic hysteresis loop are obtained. A.J.Manuel

538 : 621.318.1 : 621.374.32

7190 OPERATING CHARACTERISTICS OF A THIN FILM MEMORY. J.I.Raffel.

J. appl. Phys., Supplement to: Vol. 30, No. 4, 60S-61S (April, 1959).

An experimental prototype memory with 32 ten-bit words has been designed, built, and tested. Circular spots 1/16 in. in diameter about 600 A thick are used. These are evaporated on two pieces of glass each comprising a 16×16 spot array. An operating cycle time of less than one-half microsecond appears possible. The circuitry for driving and sensing is transistorized and the memory uses external register selection from a core-diode matrix. Word selection is provided by a transverse field and a digit winding conditions the information written by applying a longitudinal field in the "one" or "zero" direction. Extension to sizes of the order of 1000 words is planned using these techniques. The memory constructed here will soon be installed in the control element of the TX-2 computer.

538.1

7191 STRAY FIELDS OF CONICAL POLE PIECES. I.Řezanka.

Czech. J. Phys., Vol. 9, No. 2, 266-8 (1959). In Russian.

It is proposed to use conical pole pieces in the velocity-analysis of charged particles. Knowledge of the leakage fields in important and it is here shown that this can be obtained analytically by means of a simple conformal transformation.

A.E.I. Research Laboratory

538.1 : 621.318.381

7192 DESIGN OF A 100-KILOGAUSS 4-INCH CORE SOLENOID FOR CONTINUOUS OPERATION.

W.F.Giauque and D.N.Lyon.

Rec. sci. Instrum., Vol. 31, No. 4, 374-90 (April, 1960).

The design of high field cylindrical solenoid magnets for continuous operation is discussed. Equations are given relating power input, allowable temperature rise, coolant rate, and pressure drop to give the detailed dimensions required for the electrical conductor and the cooling annuli. The stresses from electromagnetic forces acting upon conductors are discussed, equations are given, and some devices and factors concerned in resisting these forces are described. The properties of kerosene as a magnet coolant and safety precautions for its use are discussed. The details for a magnet with a 4 in. air core, constructed for good homogeneity, and 7.5 MW of power are given. A procedure for preparing laminated insulation in the form of a spiral is described and a method of squaring the magnet ends to improve heat transfer, reduce heat production, and facilitate support at the ends has been devised. Equations are given which enable the evaluation of the conductor temperature at any point along the coil by making use of the temperature coefficient of resistance for thermometric purposes. A graph of conductor and kerosene temperatures as a function of axial length has been prepared from data obtained from magnet operation. The particular magnet described here, which is the first of several to be built, gave a field of 99 500 G at 7.5 MW. Some suggested improvements based on experience with the present magnet have been included.

538.1 : 621.318.381

7193 HIGH FIELD SOLENOID MAGNET WITH LIQUID NITROGEN COOLING.

T.W.Adair III, C.F.Squire and H.B.Utley.

Rev. sci. Instrum., Vol. 31, No. 4, 416-18 (April, 1960).

The high field solenoid operates at liquid nitrogen temperature (78°K), and uses a relatively small d.c. power source (100 kW). It has operated continuously and steadily at 36 kG and 62 kW under steady-state conditions. This is done by forcing the liquid nitrogen coolant through the annuli between the electrical conductors with a circulation pump. The first magnet designed has a 4.6 cm dia. core and the length is such that the central portion of the solenoid gives an experimental "working space" 10 cm in length where the field is quite uniform. The cost is modest compared to comparable water-cooled solenoids both as to initial investment and operation.

538.1 : 536.48 : 621.318.3

SUPERCONDUCTING ELECTROMAGNETS. See Abstr. 7029

ELECTROMAGNETISM
MAGNETOHYDRODYNAMICS

538.3

7194 ON THE ELECTROMAGNETIC ENERGY-MOMENTUM VECTOR. F.Uchiyama, Y.Otsuka and K.Kobayasi.

J. Coll. Arts Sci. Chiba Univ., Vol. 2, No. 3, 266-7 (March,1959). In Japanese.

538.3

7195 THE ELECTROMAGNETIC ENERGY-MOMENTUM TENSOR IN THE PRESENCE OF CHARGED MATTER, IN THE CASE OF THE NON-LINEAR COUPLING EQUATIONS OF THE BORN–INFELD THEORY. Nguyen Xuan Xinh.

C.R. Acad. Sci. (Paris), Vol. 250, No. 3, 468-70 (Jan. 18, 1960). In French.

The energy-momentum of the electromagnetic field, in the presence of charged matter, can be represented by various tensors, symmetric and asymmetric. In the theory of Maxwell their choice still not completely determined, but in the Born–Infeld theory the tensors reduce to a single symmetric tensor.

T.R.Cars

538

7196 GEOMETRICAL REPRESENTATION OF THE MAXWE FIELD IN MINKOWSKI SPACE. E.S.Lowry.

Phys. Rev., Vol. 117, No. 2, 616-18 (Jan. 15, 1960).

The electromagnetic field tensor of a classical particle is ass ciated with the orientation and density of a family of two-dimensio surfaces radially distributed about the world line of a particle in Minkowski space.

538

7197 RADIATION DAMPING OF AN ELECTRON IN A UNIFORM MAGNETIC FIELD. G.Gibson and E.J.Lau

Phys. Rev., Vol. 117, No. 5, 1188-90 (March 1, 1960).

Analytic solutions are given for the pair of differential equati obtained from classical theory which express the time rate of change of the angle between the momentum vector and the magneti field vector, and the time rate of change of the energy of the electron.

538

7198 THE INTERPRETATION OF HIGH-ORDER POLARIZA TIONS. J.Voisin.

Physica, Vol. 25, No. 3, 195-204 (March, 1959). In French.

For earlier work see for example Abstr. 1091 (1950). The polarization phenomena were investigated using the Rosenfeld metho for first orders. The effects due to the higher atomic multipole mome were introduced assuming that the medium did not contain any sur face of discontinuity. The case of media containing such a surface S was also considered. The contribution from neutral atoms to th average charge and current densities associated with S was expressed in terms of superficial higher order multipole densities o charge and current. To do this, the scalar and vector potentials d to the existence of this surface were calculated at any point, not o S.

538

7199 A SCALAR REPRESENTATION OF ELECTROMAGNETIC FIELDS. II. E.Wolf.

Proc. Phys. Soc., Vol. 74, Pt 3, 269-80 (Sept., 1959).

For Pt I see Abstr. 1478 (1954). It is shown that the scalar representation of electromagnetic fields introduced Pt I leads to a new model for energy transport. The energy may be considered t be carried by two mutually incoherent scalar waves, each of which arises from contributions of circularly polarized components of th same helicity. In a monochromatic field the energy density and th energy flow of each of these two partial waves are time-independe and the energy flow is at every point of the field in the direction o the normal to the surface of constant phase of the wave. Mathema ically, the two partial waves are represented by "analytic signals" (containing spectral components of only positive or negative frequencies) into which the complex potential of the field may be deco posed. As an immediate consequence of these results, a new repr sentation of an unpolarized quasi-monochromatic electromagnetic field is obtained and it is shown that, under usual conditions, the "complex disturbance" of the classical scalar diffraction theory of optics may be identified with the complex potential of this represe tion.

538

7200 A SCALAR REPRESENTATION OF ELECTROMAGNETIC FIELDS. III. P.Roman.

Proc. Phys. Soc., Vol. 74, Pt 3, 281-89 (Sept., 1959).

The transformation properties of the single complex quantity, introduced by Green and Wolf (Abstr. 1478 of 1954) to describe the electromagnetic field, are investigated and the physical energy–momentum tensor of this field is derived in terms of the scalar theory. In particular, it is found that the energy density, as define in the previous paper, is identical with that given by the physical energy–momentum tensor; and that the energy flow density differ from the one given by this tensor only by a divergence-free vector

538.3 : 55

7201 SOME SOLUTIONS FOR ELECTROMAGNETIC PROBLEMS INVOLVING SPHEROIDAL, SPHERICAL, AND CYLINDRICAL BODIES. J.R.Wait.

J. Res. Nat. Bur. Stand., Vol. 64B, No. 1, 15-32 (Jan.-March, 196

Solutions are presented for the low-frequency electromagneti response to an oscillating magnetic dipole by conducting bodies of simple shape. The quasi-stationary approximation is employed throughout, which is valid when the relevant dimensions of the problem are all small compared to the free-space wavelength. This amounts to matching solutions of the wave equation within the bodies to solutions of Laplace's equation outside. The results have application to geophysical prospecting.

538.3

7202 THE INFLUENCE OF A MAGNETIC FIELD ON THE STABILITY OF A BOUNDARY LAYER.

V.N.Arkhipov.

Dokl. Akad. Nauk SSSR, Vol. 129, No. 4, 751-3 (Dec. 1, 1959).
In Russian.

Rossow (Z. angew. Math. Phys. Vol. 9b, No. 5-6, 519, 1958) has calculated the velocity profile of the boundary layer of a viscous electrically conducting fluid flowing parallel to a flat plate. Here the stability of this profile is investigated, assuming perturbations which vary sinusoidally in the direction of flow and applying Galerkin's method to compute a curve of neutral stability. The results, presented graphically, indicate that a small magnetic field (Hartmann number of the order of 0.04) nearly doubles the critical Reynolds number.

O.Penrose

538.3

7203 SUPERPOSABILITY IN MAGNETOHYDRODYNAMICS. II.

J.N.Kapur.

Appl. sci. Res. A, Vol. 9, No. 2-3, 139-47 (1960).

For Pt I, see Abstr. 4831 (1959). The results of Pt I are used to discuss: (1) superposability of wave motions; (2) hydrostatic equilibrium of magnetic stars; (3) effects of viscosity in axially symmetric hydromagnetic flows; (4) axially symmetric force-free fields; (5) general force-free fields.

538.3

7204 REFLECTION AND REFRACTION OF HYDROMAGNETIC WAVES AT THE BOUNDARY OF TWO COMPRESSIBLE MEDIA.

W.E.Williams.

Astrophys. J., Vol. 131, No. 2, 438-41 (March, 1960).

The reflection and refraction of a hydromagnetic plane wave at a plane boundary between two semi-infinite homogeneous media of infinite electrical conductivity are discussed when a uniform magnetic field perpendicular to the plane of separation is present. It is shown that, if the incident wave is not an Alfvén one, there will be at most two reflected and two refracted plane waves and that, for the case of an incident Alfvén wave, there will be only one reflected and one refracted wave. It is also shown that a general solution of the hydromagnetic equations may be obtained in terms of two independent scalar fields.

538.3

7205 THE STABILITY OF NON-DISSIPATIVE COUETTE FLOW IN HYDROMAGNETICS.

S.Chandrasekhar.

Proc. Nat. Acad. Sci. U.S.A., Vol. 46, No. 2, 253-7 (Feb., 1960).

Non-viscous purely azimuthal flow of a perfectly conducting fluid between coaxial cylinders in a uniform axial magnetic field is studied. It is shown that monotonic increase of angular speed with distance from the axis is sufficient for stability. The minimum field necessary to stabilize the flow is obtained for the case of nearly equal cylinders with the velocity distribution permissible under viscous flow.

O.Penrose

538.3

7206 ON THE CHANGE IN SHAPE OF A GRAVITATING FLUID SPHERE IN A UNIFORM EXTERNAL ELECTRIC FIELD.

S.P.Talwar and S.S.Abbi.

Proc. Nat. Inst. Sci. India A, Vol. 22, No. 1, 7-12 (1956).

The stability of a conducting, gravitating, incompressible fluid sphere in a uniform external electric field is discussed by two different methods — the "energy method" and the "equilibrium method". The results obtained by both methods show that the stable configuration is a prolate of ellipticity,

$$\epsilon/R = \frac{5\,E^2R^4}{2\,GM^2}$$

538.3

7207 ON THE STABILITY OF A GRAVITATING SPHERE IN A MAGNETIC FIELD.

R.K.Jaggi.

Proc. Nat. Inst. Sci. India A, Vol. 23, No. 6, 560-6 (1957).

The stability of a gravitating sphere under the action of different magnetic fields for models considered by earlier authors has been discussed. Employing the "energy method" it is found that under a P_2 deformation the equilibrium configurations arrived at by them are stable.

538.3

7208 A NOTE ON ROTATING CONFIGURATION ASSOCIATED WITH TOROIDAL MAGNETIC FIELD.

B.Shankaranarayana Rao.

Proc. Nat. Inst. Sci. India A, Vol. 24, No. 6, 315-18 (1958).

The equilibrium form of an incompressible fluid mass rotating about an axis in presence of a toroidal magnetic field, whose axis coincides with the axis of rotation, is discussed and the conditions that the equilibrium configuration may be a sphere, a prolate spheroid or an oblate spheroid are derived.

538.3

7209 ON THE PULSATIONS OF AN INFINITE CYLINDER WITH A FORCE-FREE MAGNETIC FIELD.

B.B.Chakraborty and P.Ramamoorthy.

Z. Astrophys., Vol. 49, No. 3, 186-91 (1960).

Discusses the problem of radial pulsations of an infinitely conducting infinite fluid cylinder under its own gravity and a force-free magnetic field whose components in cylindrical coordinates are

$$H_0 = [0, A_1J_1(\alpha\bar{\omega}), A_1J_0(\alpha\bar{\omega})].$$

For different magnitudes of the field strength the displacement function and the change in the magnetic field inside the cylinder are calculated for the fundamental modes of the vibrations. The ratios of the periodic times with a magnetic field present to those without the magnetic field are also determined.

538.3 : 534.22

7210 EFFECT OF GAS PRESSURE AND CONE ANGLE ON THE VELOCITIES OF ELECTRICALLY EXCITED SHOCK WAVES.

P.J.Hart.

J. appl. Phys., Vol. 31, No. 2, 436-7 (Feb., 1960).

Velocities of shocks from sparks between a central electrode and an outer cylindrical electrode, separated by a conical insulator, depend on the cone angle, on the nature and surface condition of the insulator, and on pressure. At low pressure (~ 0.03 mm Hg) the highest velocities are for large angles. Effects are explained by Joule heating and direction of magnetic field of the spark.

A.G.Gaydon

538.3 : 537.56

7211 RADIAL HYDROMAGNETIC OSCILLATIONS.

G.B.F.Niblett and T.S.Green.

Proc. Phys. Soc., Vol. 74, Pt 6, 737-43 (Dec., 1959).

This paper discusses the radial hydromagnetic oscillations of a plasma confined by an axial magnetic field. Oscillations of this type have recently been observed experimentally and typical high-speed streak photographs are presented and analysed. On the assumption that the plasma is confined in a thin cylindrical annulus, the non-linear equation of motion can be integrated analytically. The calculated period of the oscillations is independent of amplitude and is found to be in good agreement with experimental results. Damping of the oscillations by diffusion of the magnetic field is discussed and reference made to the possible significance of the oscillations as a mean of transferring energy irreversibly to the ions.

538.3 : 62

ELECTROMAGNETIC STIRRING OF LIQUID METALS. See Abstr. 6531

ELECTROMAGNETIC WAVES AND OSCILLATIONS

538.56

7212 INVESTIGATION OF POPULATION INVERSION IN HELIUM.

W.J.Condell, Jr, O.Van Gunten and H.S.Bennett.

J. Opt. Soc. Amer., Vol. 50, No. 2, 184-5 (Feb., 1960).

Experiments were performed following the suggestions by Sanders (Abstr. 1202 of 1960) and Javan (Abstr. 1109 of 1960) that population inversion may be producable in a discharge in helium which could be used for maser amplification. The intensities of the

$3'D_2$ to $2'P_1$ transition at 0.6678μ and the $2'P_1$ to $2'S_0$ transition at 2.0582μ were used to measure the populations of the $2'P_1$ and $3'D_2$ states. Under the conditions of pressure and current used no inversion of population was observed. This result could be partially explained by cascading and resonance radiation trapping. The authors do not anticipate that different regions of current and/or pressure will allow sufficient population as well as inversion to afford optical maser action. J.M.Baker

538.56 : 530.12

EXPERIMENTAL TEST OF SPECIAL RELATIVITY, USING TWO MASER OSCILLATORS. See Abstr. 6656

538.56 : 621.375.9

7213 PARAMETRIC AMPLIFICATION.

K.W.H.Stevens.

J. sci. Instrum., Vol. 37, No. 1, 1-5 (Jan., 1960).

A review of the underlying ideas of parametric amplification. The discussion is mainly in physical terms and passes from simple circuit amplifiers to the more complex Suhl-types of amplifier. Mention is made of some of the directions in which research is proceeding.

538.56 : 621.375.9

7214 PARAMETRIC AMPLIFICATION ALONG NONLINEAR TRANSMISSION LINES.

R.Landauer.

J. appl. Phys., Vol. 31, No. 3, 479-84 (March, 1960).

A pump signal propagating along a dispersionless transmission line with a distributed nonlinear capacitance is subject to deformation, since different parts of the signal move with different velocities. This process of deformation will eventually result in the formation of an electromagnetic shock wave. The deformation will affect the parametric amplification process. If a small signal consisting of a positive pulse, short compared to the pump cycle, is added to the pump signal at the input end, then it is shown that the small signal at the output must be non-negative. All other small signals, including in particular those with sinusoidal time variation, can be regarded as superpositions of these short pulses. As a consequence it is shown that, in general, a sinusoidal signal will not be increased in its fundamental frequency component, by travelling down the line together with the pump signal. There are certain exceptional frequencies, multiples of one half the pump frequency, where a suitably phased small signal may be increased at its fundamental frequency, but not by a sufficient amount to be of practical interest.

538.56 : 621.375.9

7215 CONCERNING THE TRANSMISSION OF SIGNALS OF ANY FORM WITH THE AID OF A DEGENERATE PARAMETRIC AMPLIFIER.

F.Bertein and A.Jelenski.

C.R. Acad. Sci. (Paris), Vol. 250, No. 1, 88-90 (Jan. 4, 1960). In French.

A condensed introduction to a general analysis of diode parametric amplifiers is presented. S.A.Ahern

538.56 : 621.317.763

7216 ACCURATE MICROWAVE WAVEMETERS WITH CONVENIENT CALIBRATION TABLES.

H.E.Bussey and A.J.Estin.

Rev. sci. Instrum., Vol. 31, No. 4, 410-13 (April, 1960).

Accurate and convenient microwave cavity wavemeters are described that are suitable for many precise physical measurements. High Q's were attained by refined construction techniques. At 9000 Mc/s a precision of 0.02 Mc/s was obtained. The absolute accuracy also may be very high after strains in the metal have stabilized. A calibration table containing 10^4 entries, easily formed by means of a high speed computer, makes the wavemeters convenient to use. The curve fitting method, accurate to one in 10^6, is described.

538.56 : 62

A HIGH FREQUENCY ELECTROMAGNETIC METHOD OF CHECKING THE PROPERTIES OF THE SURFACE LAYERS ON DETAILS. See Abstr. 6530

538.56 : 621.385.623.5 : 621.316.726

7217 FREQUENCY STABILIZATION OF A REFLEX KLYSTRON OSCILLATOR.

F.Bruin and D.van Ladesteyn.

Physica, Vol. 25, No. 1, 1-8 (Jan., 1959).

A description is given of a servo, stabilizing the frequency of a microwave oscillator to the resonance frequence of a cavity, modulated at an audio frequency. The stabilizer requires no re-adjustment and is designed especially for very short waves and continuo operation.

538.56 : 530

PROPAGATION OF A STRONG ELECTROMAGNETIC–GRAVITATIONAL WAVE IN VACUUM. See Abstr. 6676

538.56 : 621.396.

7218 CURRENT WAVES IN A THIN CYLINDRICAL CONDUCTOR. I. CURRENTS AND IMPEDANCE OF A TRANSMITTING ANTENNA.

L.A.Vainshtein.

Zh. tekh. Fiz., Vol. 29, No. 6, 673-88 (June, 1959). In Russian. English translation in: Soviet Physics—Technical Physics (New Y Vol. 4, No. 6, 601-16 (Dec., 1959).

Treats the excitation of a transmitting cylindrical aerial by a external electromotive force applied to an arbitrary point on the aerial. The study is based on Leontovich and Levin's integrodiffer ential equation for the current in a thin wire [Zh. tekh. Fiz., Vol. 1 No. 9, 481 (1944)], and is equivalent to the "linearized" integral equation of Hallen (1938), but instead of being expanded in powers a small parameter, the current is represented as the sum of three travelling waves (a wave beginning at the point of excitation and tw waves beginning at the ends of the conductor), whose complex amp tudes can be regarded as slowly varying functions. These function (or, more exactly, their derivatives), are shown to satisfy a Volter integral equation of the first kind. The kernel of this integral equation depends only on the difference of the variables, so that th the solution of the equation is found in terms of quadratures. This solution makes it possible to find the current at any point of the co ductor, to calculate the input impedance of the aerial etc. The acc racy of this method is discussed, together with its relation to method of expansion in powers of a small parameter.

538.56 : 621.396.

7219 CURRENT WAVES IN A THIN CYLINDRICAL CONDUC TOR. II. THE CURRENT IN A PASSIVE OSCILLATOR AND THE RADIATION OF A TRANSMITTING ANTENNA.

L.A.Vainshtein.

Zh. tekh. Fiz., Vol. 29, No. 6, 689-99 (June, 1959). In Russian. Englis translation in: Soviet Physics—Technical Physics (New York), Vo No. 6, 617-26 (Dec., 1959).

A study is made of the currents excited by a plane incident wa in a thin cylindrical conductor, and it is shown that these currents can be expressed in terms of the function $\Psi(x,q)$ introduced in the preceding abstract. It is shown that by using the reciprocity theor it is possible to calculate the radiation field of a transmitting aeri The expression obtained for its radiation characteristic makes it possible to form an intuitive idea of the mechanism of production c the field of a transmitting aerial, and thus to refine the solution of the problem considered in Pt I.

538.

7220 ON THE REFLECTION OF ELECTROMAGNETIC WA FROM A MEDIUM EXCITED BY ACOUSTIC WAVES.

H.J.Schmitt and D.L.Sengupta.

J. appl. Phys., Vol. 31, No. 2, 439-40 (Feb., 1960).

Acoustic waves (60 kc/s) in water, normal to the surface, we observed to modulate the electromagnetic wave ($\lambda = 3.2$ cm) refle from the surface. A brief theory is given. J.Jarzyns

538.56 : 535.

7221 RELATIONS CONCERNING REFRACTING SURFACES, WAVEFRONTS, AND PHASE ERRORS.

D.K.Cheng.

J. Franklin Inst., Vol. 269, No. 3, 184-95 (March, 1960).

Using the vector notation of differential geometry, general relationships connecting the incident wavefront, two refracting surfaces, and the refracted wavefront have been analysed. Formu have been derived for determining the equation of the fourth when the expressions of the other three surfaces are given. These formulae are useful for the determination of aperture phase error in a defocused lens and for microwave lens design.

538.56 : 621.396

7222 BASIC EXPERIMENTAL STUDIES OF THE MAGNETI FIELD FROM ELECTROMAGNETIC SOURCES IMMERSED IN A SEMI-INFINITE CONDUCTING MEDIUM.

M.B.Kraichman.

J. Res. Nat. Bur. Stand., Vol. 64D, No. 1, 21-5 (Jan.-Feb., 1960)

Using electromagnetic sources consisting of various dipoles and loops immersed in a concentrated sodium chloride solution, measurements were made verifying the magnetic field propagation equations in air, derived previously by several authors. The receiver was farther away from the source than a wavelength in the conducting medium, but much closer than a wavelength in air. An expression is derived giving the value of the magnetic field in air due to a rectangular loop with a horizontal axis by assuming the loop to consist of two electric dipoles corresponding to the horizontal members. Experimental data verifying this expression are presented. Measurements were made using submerged electric dipoles, of the magnetic field in air, which show that the field is determined solely by the current in the horizontal radiating wires of the dipoles.

538.56

7223 A RECIPROCITY THEOREM FOR THE ELECTROMAGNETIC FIELD SCATTERED BY AN OBSTACLE.

A.T.De Hoop.

Appl. sci. Res. B, Vol. 8, No. 2, 135-40 (1960).

When a time-harmonic plane electromagnetic wave is incident upon a scattering obstacle of finite dimensions, the far-zone scattered field satisfies a reciprocity relation. This reciprocity relation is derived with the aid of Lorentz's theorem. The result is valid under rather general assumptions as far as the electromagnetic properties of the obstacle are concerned. As a special case, the result for a perfectly conducting obstacle is obtained.

538.56

7224 THEORY OF DIFFRACTION IN MICROWAVE INTERFEROMETRY. D.M.Kerns and E.S.Dayhoff.

J. Res. Nat. Bur. Stand., Vol. 64B, No. 1, 1-13 (Jan.-March, 1960).

Microwave Michelson and Fabry–Perot interferometers are respectively considered as instances of: (1) a "reflection system", consisting of a radiating–receiving system and a reflecting object (e.g. a finite mirror); (2) a "transmission system", consisting of a radiating system and a receiving system with an object (e.g. a Fabry–Perot etalon) interposed. The basic theoretical objective is the calculation of the amplitude and phase of the (time-harmonic) received signal in the systems considered. The electromagnetic field in space transmission paths is represented in terms of continuous angular spectra of vectorial plane waves, and the elements of the systems are described by means of suitable tensor scattering matrices (having both discrete and continuous indices). Needed scattering matrices are considered known; relationships to experimentally determinable data are outlined. The general case of either the reflection or transmission system is soluble formally in terms of a series of integrals stemming from the Liouville–Neumann series solution of certain integral equations. Formulae are obtained for models of the Michelson and Fabry–Perot instruments with arbitrary radiating and receiving characteristics. The theory and various features of the instruments considered, including Fresnel-region (or quasi-optical) behaviour, are illustrated by means of examples obtained by choosing relatively simple and rather hypothetical analytical expressions for the radiating and receiving characteristics.

538.56

7225 THE PLANE PROBLEM OF THE DIFFRACTION OF ELECTROMAGNETIC WAVES BY TWO IDEALLY CONDUCTING [INFINITELY THIN] STRIPS OF FINITE WIDTH, LOCATED ONE BELOW THE OTHER. Yu.V.Pimenov.

Zh. tekh. Fiz., Vol. 29, No. 6, 711-15 (June, 1959). In Russian. English translation in: Soviet Physics — Technical Physics (New York), Vol. 4, No. 6, 638-42 (Dec., 1959).

A method of successive approximations is used, together with a special approximation formula (See Abstr. 3671 of 1959).

538.56 : 534.26

THE DIFFRACTION OF A PLANE WAVE THROUGH TWO OR MORE [PARALLEL] SLITS IN A PLANE SCREEN. See Abstr. 6876

538.56 : 535.42

A NOTE ON DIFFRACTION BY A HALF PLANE. See Abstr. 6949

538.56

7226 A NEW METHOD FOR SOLVING THE PROBLEM OF THE DIFFRACTION OF ELECTROMAGNETIC WAVES BY A THIN [IDEALLY] CONDUCTING DISK.

N.N.Lebedev and I.P.Skal'skaya.

Zh. tekh. Fiz., Vol. 29, 700-10 (June, 1959). In Russian. English translation in: Soviet Physics — Technical Physics (New York), Vol. 4, No. 6, 627-37 (Dec., 1959).

It is shown that the solution can be expressed in quadratures by means of two auxiliary functions, each of which satisfies a one-dimensional Fredholm integral equation with a continuous kernel. A simple formula for the scattering coefficient is obtained; for small values of ka, this formula goes over into the formula of Andrejewski (Abstr. 8588 of 1953).

538.56

7227 THE DEBYE ABSORPTION OF ELECTROMAGNETIC WAVES IN CEMENT. J.Le Bot.

J. Phys. Radium, Vol. 18, No. 11, 638-9 (Nov., 1957). In French.

Results are given of the temperature variation (4-350°K) for various cements at frequencies of 0.1, 1, 10 and 100 kc/s. They depend on the water content and constituents of the cement and also its preliminary treatment. J.R.Mallard

538.56

7228 THE POSSIBILITY OF PASSAGE OF ELECTROMAGNETIC WAVES THROUGH A METAL IN A STRONG MAGNETIC FIELD. O.V.Konstantinov and V.I.Perel'.

Zh. eksper. teor. Fiz., Vol. 38, No. 1, 161-4 (Jan., 1960). In Russian.

It is shown that an electromagnetic wave travelling along a magnetic field can penetrate through a metal plate held perpendicular to the field provided the Larmor frequency exceeds the wave frequency and is much higher than the collision frequency, and provided the Larmor electron radius is smaller than the length of the wave in the metal.

538.56 : 621.372.8

7229 WAVE PROPAGATION IN AN INHOMOGENEOUS TRANSVERSELY MAGNETIZED RECTANGULAR WAVEGUIDE. Chen To Tai.

Appl. sci. Res. B, Vol. 8, No. 2, 141-8 (1960).

Studied with the aid of a modified Sturm–Liouville differential equation. A detailed discussion is given of the power relationship. Application of the Rayleigh–Ritz method to the approximate calculation of the eigenvalues is outlined, yielding a general secular determinental equation. Several models are proposed to illustrate how the exact eigenvalues of this new class of boundary-value problems are to be determined.

538.56 : 534.21 : 621.372.829

7230 THEORY OF WAVE PROPAGATION IN VARIABLE CROSS-SECTION WAVEGUIDES.

G.Ya.Lyubarskii and A.Ya.Povzner.

Zh. tekh. Fiz., Vol. 29, No. 2, 170-9 (Feb., 1959). In Russian. English translation in: Soviet Physics—Technical Physics (New York), Vol. 4, No. 2, 146-54 (Feb., 1959).

Uses a generalization of the W.K.B. method. It can be applied to both acoustic and electromagnetic waveguides and it is assumed that the guide comprises two truncated cones connected by a section of variable cross-section, which partly transmits and partly reflects the waves launched in one of the cones. The phases and amplitudes of all the reflected and transmitted waves (both of which groups have various modes) are determined, together with the field and dispersion dependence inside the variable section.

538.56 : 621.372.829

7231 STEP AND TAPER WAVEGUIDE SECTIONS WITH ROUNDED CORNERS. Lin Wei-guan.

Science Record (China), New Series, Vol. 4, No. 3, 170-81 (March, 1960).

Using the method of conformal transformations, a study is made of the maximum electric field in a taper section with various taper angles. It is seen that the effect of the heigh ratio on the magnitude of the maximum intensity is small. The properties of a step section are investigated in detail, and the discontinuous capacity of the step section with rounded angle is obtained. Assuming that $b_2/b_1 = \infty$, the power carrying capacity of taper sections is also considered.

538.56 : 534.23

DESIGN OF STRIP ARRAYS. See Abstr. 6868

538. 56

7232 THE REFLEXION OF RADIO WAVES FROM A STRATIFIED IONOSPHERE MODIFIED BY WEAK IRREGULARITIES. M.L.V.Pitteway.

Proc. Roy. Soc. A, Vol. 246, 556-69 (Aug. 26, 1958).

Consideration is given to the scattered wave which accompanies reflection from a stratified ionosphere in which there are weak irregularities. By considering these irregularities to be confined to a thin layer near a given height, the possibility is examined that they might produce considerably enhanced scattering if they were situated near the reflection level calculated on the basis of geometrical optics. It is found that they would not have a very much greater effect at this level. It is also shown that, if the electron collision frequency is of the order likely to be encountered in the real ionosphere, there would be little enhancement by "resonance" effects of the kind suggested by Herlofson (1951).

538.56

7233 THE NUMERICAL SOLUTION OF DIFFERENTIAL EQUATIONS GOVERNING THE REFLEXION OF LONG RADIO WAVES FROM THE IONOSPHERE. III.
D.W.Barron and K.G.Budden.
Proc. Roy. Soc. A, Vol. 249, 387-401 (Jan. 13, 1959).

The previous papers in this series (see Abstr. 2908, 5538 of 1955) have dealt with the differential equations governing the reflection of long and very long radio waves from the ionosphere. In the present paper these equations are cast in a simpler form by using a generalized matrix admittance function A, and the corresponding equations are obtained in a form suitable for numerical integration by a step-by-step process from properly chosen initial solutions. From the value of A so obtained for a point below the ionosphere the reflection coefficient matrix R is obtained, whose elements include the familiar reflection coefficients. The equations are given in full for one case. The equations, and the computational procedure, are checked by using them to calculate the reflection coefficients of a sharply bounded homogeneous ionosphere and comparing the result with that calculated by other methods. The new method of calculation is considerably faster than the old and will make possible calculation for higher frequency waves where many more steps are needed in the numerical integration. A theorem on the equivalence of certain directions of propagation is stated and proved.

538.56 : 621.391.812.63

7234 THE PROPAGATION OF RADIO WAVES OF FREQUENCY LESS THAN 1 kc. E.T.Pierce.
Proc. Inst. Radio Engrs, Vol. 48, No. 3, 329-31 (March, 1960).

The simplfied mode theory of propagation in a waveguide formed by the earth and a concentric ionosphere of constant height is applied to the experimental observations of Chapman and Macar (Abstr. 6037 of 1956) for the frequency range between 100 and 1000 c/s. It is demonstrated that discrepancies between theory an night-time experimental results may be explained by modifying the theory and postulating an effective increase in ionospheric height as frequency decreases. This concept is also shown to be not necessarily incompatible with results for day-time.

Radiofrequency Spectroscopy Techniques

538.

7235 A SIMPLE NUCLEAR MAGNETIC RESONANCE SPECTROMETER. R.Becherer.
C.R. Acad. Sci. (Paris), Vol. 250, No. 6, 1037-9 (Feb. 8, 1960). In French.

The use of a radiofrequency synchronous detector at the output of a conventional crossed-coil system gives a somewhat improved signal-to-noise ratio and eliminates the need for accura adjustment of the coils. E.F.W.Seymo

538.56 : 538

7236 THE CONSTRUCTION OF HIGH RESOLUTION NUCLEAR RESONANCE SPECTROGRAPHS. Ia - Ib.
H.Primas, R. Arndt and R.Ernst.
Z. InstrumKde., Vol. 67, No. 12, 293-300 (Dec., 1959) Vol. 68, No. 8-13 (Jan., 1960). In German.

A detailed discussion of the techniques used to obtain highly homogeneous (1 in 10^8) and stable magnetic fields of 1 to 15 kG, using either electro- or permanent magnets for high-resolution n.m.r. spectroscopy use. J.G.Powle

NUCLEAR AND ATOMIC PHYSICS

539

7237 ATOMIC UNITS.
H. Shull and G.G.Hall.
Nature (London), Vol. 184, 1559-60 (Nov. 14, 1959).

Suggests a standardization of units used in reporting results of atomic and molecular calculations, based on the Hartree scheme, the suggested basic quantities being the unit of energy (the "Hartree") $H = me^4/\hbar^2$, and the unit of length (the "Bohr") $b = \hbar^2/me^2$, and the unit of electric moment, eb (for which no name or notation is suggested). Conventions are suggested for denoting that a reduced mass, or a modified charge, has been used. J.Hawgood

APPARATUS . PARTICLE DETECTORS

539.1.07

7238 SELF-QUENCHING GEIGER COUNTERS CONTAINING MIXTURES OF PERMANENT GASES.
A.J.L.Collinson, I.C.Demetsopoullos, J.A.Dennis and J.M.Zarzycki.
Nature (London), Vol. 185, 369 (Feb. 6, 1960).

Results are given of an experimental investigation of the characteristics of $A—Xe—O_2—N_2$ counters originally described by Shore (Abstr. 3205 of 1950). A discussion on the role of the various constituents in the quenching mechanism is given. J.M.Zarzycki

539.1.07

7239 FIRING CHARACTERISTICS OF HALOGEN-QUENCHED GEIGER-MÜLLER COUNTERS. S.Pal Puri and P.S.Gill.
Proc. Nat. Inst. Sci. India A, Vol. 24, No. 1, 66-77 (1958).

A few discharge parameters of low voltage halogen-quenched counters are presented and contrasted with those of the conventional argon—alcohol counters. The discrepancies which are mainly quantitative are easily understood if photons are considered to liberate secondary electrons from the cathode unlike the photoionization in the other counters. No new mechanism of either metastable forma or resonance radiation finds support from the time correlation of the individual avalanches. The greater attenuation length of the radiation, seemingly due to far less absorption, explains adequatel the ineffectiveness of beads, the larger output pulse and the greate probability of discharge spread. The formative time lag in the pul build up and the greater ascent of the leading edge manifest themselves due to the "transit lag" of electrons in these low fields. Th velocity of discharge spread compared favourably with the values i case of externally quenched counters.

539.1.0

7240 IMPROVEMENT OF THE PLATEAU OF ARGON—ALCOHOL FILLED METAL-SHEATH GEIGER-MÜLLE COUNTERS. J.Kern and O.Huber.
Helv. phys. Acta, Vol. 33, No. 1, 27-52 (1960). In French.

The construction of a metallic counter is described. Spurious counts are successfully suppressed by a careful choice of wire diameter. For the elimination of end effects a new arrangement wi two concentric guard rings was finally developed. With argon—alcohol mixture, the plateau shows a slope of 0.6% over 150 V in "homogeneous" irradiation. Using a collimated beam of gamma ra 0.24% over 160 V is obtained. It is shown that in the latter case th residual slope is due exclusively to the decreasing of the deadtime with increasing over-voltage.

539.1.0

7241 LOW BACKGROUND THIN-WALL FLOW COUNTERS FOR MEASURING BETA ACTIVITY OF SOLIDS.
D.Lal and D.R.Schink.
Rev. sci. Instrum., Vol. 31, No. 4, 395-8 (April, 1960).

The construction and performance of disk-shaped thin-walled flow counters suitable for measuring very small beta activities of solids is described. The circular faces, which serve as the cathod consist of conducting films. Either a single pear-shaped loop of wire whose plane is parallel to that of the faces, or a group of straight wires stretched across the midplane serves as the anode.

The counters are operated in the Geiger region. Samples can be counted against both faces of the counter. Performance data are given for counters having active volumes ranging from 0.2 to 7 cm^3 and having active areas from 1.6 to 23 cm^2. Counting efficiencies for natural potassium (mounted on Lucite) vary from 30% to 47%, depending on the relationship of sample area to counter dimensions. Inside a 20 cm steel shield and an anticoincidence ring the background counting rates varied approximately as 1 count/hr per cm^2 of counting area. Backgrounds as low as 1 count/hr were obtained. The disk geometry permits the use of a smaller metal and anticoincidence shield than is possible with cylindrical geometry. Counters shielded successively with 1.9 cm mercury, 5 cm steel, and 5 cm lead, and operated with a flat multiple-anode anticoincidence counter (15 cm^2), actually gave lower background than with the 20 cm steel and anticoincidence ring assembly. An integral counter assembly, consisting of ~2 cm diam. disk-shaped counter and a disk-shaped guard counter (~ 7 cm diam), was constructed and gave satisfactory results.

539.1.07

7242 PRACTICAL USE OF A PRESSURE IONIZATION CHAMBER FOR THE DETERMINATION OF ABSOLUTE INTENSITY OF GAMMA RAYS. P.Savel.

J. Phys. Radium, Vol. 18, No. 8-9, 518-19 (Aug. - Sept., 1957).
In French.

The efficiency of an ionization chamber for γ-rays having been determined, a formula is given for the calculation of the absolute value of a γ-ray source, upon the condition that the disintegration scheme is known.

539.1.07

7243 STANDARD FREE-AIR CHAMBER FOR THE MEASUREMENT OF LOW ENERGY X-RAYS (20 to 100 KILOVOLTS-CONSTANT-POTENTIAL). V.H.Ritz.

J. Res. Nat. Bur. Stand., Vol. 64C, No. 1, 49-53 (Jan.-March, 1960).

A description of the National Bureau of Standards' "low" energy free-air chamber is given. The standard chamber is designed to measure the exposure dose in roentgens for X-ray beams generated at potentials from 20 to 100 kilovolts-constant-potential (kVcp) with filtrations ranging from 2 mm of beryllium to 2 mm of beryllium plus 4 mm of aluminium. The chamber is compared with the National Bureau of Standards "medium" energy standard at 60, 75, and 100 kVcp with filtrations of 3, 3 and 4 mm of aluminium, respectively. The two standard chambers agreed to within 0.3 percent.

539.1.07

7244 METHOD FOR DETECTING NON-PROPORTIONALITY OF RESPONSE FOR GAMMA-RAY SCINTILLATORS. R.W.Peelle and T.A.Love.

Rev. sci. Instrum., Vol. 31, No. 2, 205-6 (Feb., 1960).

Briefly describes a method for studying the light output — absorbed gamma-ray energy for NaI:Tl crystals. Use is made of a source which emits a pair of gamma-rays in cascade. The "sum peak" in the pulse spectrum indicates an energy which is compared with the sum of the known energies of the two separate gamma-rays and a non-linearity can thus be detected. J.D.Craggs

539.1.07

7245 DIFFERENCE IN SHAPE OF SCINTILLATION PULSES DUE TO γ RAYS AND TO NEUTRONS. F.Cambou and G.Ambrosino.

C.R. Acad. Sci. (Paris), Vol. 250, No. 6, 1034-6 (Feb. 8, 1960).
In French.

An E.M.I. type 6097 photomultiplier and an anthracene crystal were used to investigate the pulses from γ-rays of a variety of energies up to 2.7 MeV and the pulses from 3 MeV neutrons. The response of the scintillator was examined by varying the dynode resistance. The results obtained indicate that the fast component is about 18% greater for scintillations due to γ-rays than for those due to neutrons. The percentage of the slow and fast components of scintillation pulses due to γ-rays are 10 and 90 respectively and those due to neutrons are 24 and 76 respectively. C.F.Barnaby

539.1.07 : 539.16

SCINTILLATION SPECTROMETER FOR COINCIDENCE WORK ON α β AND γ RAYS. See Abstr. 5675

539.1.07 : 539.2 : 535.37

THE RESPONSE OF PLASTIC SCINTILLATORS TO PROTONS. See Abstr. 6204

539.1.07 : 539.2 : 535.37

DIFFERENCES IN FLUORESCENCE DECAY IN ZnS:Ag FOR PARTICLES OF DIFFERENT IONIZATION DENSITY. See Abstr. 6203

539.1.07

7246 PULSE HEIGHT DISTRIBUTION OF ČERENKOV COUNTERS. R.J.Wagner.

Rev. sci. Instrum., Vol. 31, No. 3, 271-8 (March, 1960).

The problem of determining the distribution of path lengths of an isotropic flux of particles passing through a cylinder is solved analytically. The distribution function is shown graphically for cylinders of various height-to-diameter ratios and the mean path length is calculated in each case. The distribution function for some special cases of shielded cylinders also is discussed.

539.1.07

7247 AN N—P JUNCTION USED AS A CHARGED PARTICLE DETECTOR. G.Amsel, P.Baruch and O.Smulkowski.

C.R.Acad. Sci. (Paris), Vol. 250, No. 8, 1468-70 (Feb. 22, 1960).
In French.

Describes work on the use of an n—p junction prepared by the diffusion of gallium to a depth of 5 μ into silicon. The detector may be used at room temperature and has a linear response, a rise time of about one microsecond, and good resolution (about 2% for protons at 1.5 MeV). As an example of the use of this type of detector in the detection of charged particles the excitation curve for elastic scattering of deuterons from O^{16} and Al^{27} from $0.9 \le Ed \le 2$ MeV is given. The junction is insensitive to γ-rays and neutrons. R.H.Thomas

539.1.07

7248 THE PRINCIPLE OF, AND PRELIMINARY EXPERIMENTS WITH A NEW DETECTOR PERMITTING THE PHOTOGRAPHY OF TRAJECTORIES OF IONIZING PARTICLES IN A GAS. G.Charpak.

J. Phys. Radium, Vol. 18, No. 8-9, 539-40 (Aug.-Sept., 1957).
In French.

The formation of electron cascades by ionizing radiation in a mixture of argon and propane is studied as a function of the duration and the strength of the applied electric field. S.J.St-Lorant

539.1.07

7249 DISCRIMINATOR LOSSES IN PROTON-RECOIL FAST-NEUTRON DOSIMETERS. Iu.I.Petrov.

J. Nuclear Energy, Vol. 8, No. 4, 244-6 (Jan., 1959). English translation of article in : Atomnaya Energiya, Vol. 3, 326 (1957).

539.1.07 : 61

7250 EXIT DOSIMETER FOR EFFECTIVE PATIENT THICKNESS. R.G.Woodley, E.L.Bronstein and J.S.Laughlin.

Radiology, Vol. 74, No. 2, 273-8 (Feb., 1960).

The effective patient thickness is the thickness of water having the same exit dose as that observed for the patient. The design, construction and calibration of the exit dosimeter is described and measurements on the trunk of 24 patients with 2 MeV radiation show that fields in the region of an air-containing lung are the only ones where the equivalent thickness differs significantly from the patient's dimensions. The effect of this on a therapeutic treatment of the lung is discussed. J.R.Mallard

539.1.07

7251 THE EXTREME SMALLNESS OF THE MAXIMUM PERMISSIBLE INTAKE OF RADIONUCLIDES MAKES PRESENT RADIATION DETECTORS USELESS. P.O.Robert.

J. Phys. Radium, Vol. 18, Suppl. No. 7, 103A-105A (July, 1957). In French.

The maximum permissible intake of the various radionuclides that present practical danger in the nuclear industries and correspond to an amount of 150 rem accepted for a life-span of 70 years varies from 1.4×10^{-13} mg to 1.21 mg. The present radiation detectors are not adapted to this specific problem. The use of masks providing a rigorous filtering of dusts is imperative.

539.1.07

7252 DIRECT METHOD FOR DETERMINING THE VELOCITY OF NUCLEAR PARTICLES. B.F.Hampton.

J. sci. Instrum., Vol. 37, No. 2, 56-60 (Feb., 1960).

A new method of directly determining the velocity of nuclear particles in a cloud chamber is described. It is not necessary to know the mass or charge of the particle, and measurements of radius of curvature are not involved. The principle is to make the cloud chamber in the form of a resonant microwave cavity, the electric field in the cavity being very close to breakdown. Under these conditions additional ionization takes place when the electric field is a maximum, i.e. twice per cycle, resulting in a track that is modulated in intensity. With an applied field of 3000 Mc/s the time marks are spaced at intervals of 2.7 mm for an α-particle having an energy of 5.6×10^6 eV. The apparatus is described, and a method of feeding 85% of the output of a magnetron into a resonant cavity is given. A certain amount of success was obtained using hydrogen as the working gas. Limitations of the apparatus are discussed and further improvements suggested.

539.1.07

7253 NUCLEATION OF BUBBLES IN SUPERHEATED AQUEOUS SOLUTIONS BY FAST PARTICLES.

J.A.Ghormley.

J. nuclear Energy, Vol. 6, No. 4, 300-2 (May, 1958).

Energy loss along the track of a fission recoil or α-particle in superheated uranyl sulphate solution or the recoil from a fast-neutron collision in superheated ether can account for evaporation of sufficient liquid to form bubble nuclei under conditions where nucleation is observed. The contribution of charge repulsion cannot be determined from experimental results.

539.1.07

7254 RAPID CYCLING BUBBLE CHAMBER. C.W.Vernon.

Rev. sci. Instrum., Vol. 31, No. 4, 421-4 (April, 1960).

The operation of the 500 cm^3 compressed nitrogen driven propane bubble chamber at cycling rates up to 15 c/s is described. A vapour pressure of 310 lb/in^2 is found as optimum with a 540 lb/in^2 compression pressure and a 7% volume change. The chamber was expanded into a 170 lb/in^2 exhaust chamber. Excessive boiling and sensitive time are related to the cycling rate and expansion time.

539.1.07

7255 A STUDY OF THE SENSITIVITY OF AGFA K2 NUCLEAR EMULSION BY MEANS OF THE ISOTOPE I^{131}. E.Bujdosó and L.Medveczky.

Acta phys. Hungar., Vol. 7, No. 1, 135-40 (1957). In German.

From measurements of the grain density as a function of the range of electrons from I^{131} an estimate of the sensitivity of Agfa K2 emulsion, in the region of 80-90 keV, is obtained. It is found that very sensitive grains form only about 2-4% of the total number grains. S.J.St-Lorant

539.1.07

7256 STUDIES OF IONIZATION PARAMETERS IN NUCLEAR EMULSIONS.

M.Blau, S.C.Bloch, C.F.Carter and A.Perlmutter.

Rev. sci. Instrum., Vol. 31, No. 3, 289-97 (March, 1960).

A semiautomatic instrument for ionization measurements in emulsion is described briefly. The instrument was used in the investigation of the various parameters. Deviations from a purely exponential gap-length distribution were observed, a result found earlier by Cortini et al. This observation limits the usefulness of the mean gap length as a parameter. A new parameter based on the blob-length distribution, which is useful over the entire ionization range, is proposed. The relation of this parameter to grain density is discussed. It is shown that the behaviour of the latter (determined from the blob-length distribution) as a function of restricted ionization loss seems to be in agreement with theoretical expectations, with the exception of the very dense region, where appropriate corrections are proposed.

539.1.07

7257 ON THE USE OF NUCLEAR EMULSIONS FOR MEASURING THERMAL-NEUTRON DENSITIES IN UNIFORM MEDIA. C.Beets and H.Breny.

J. nuclear Energy, Vol. 6, No. 3, 197-211 (1958).

A detailed study has been made of the well-known method using boron-loaded nuclear emulsions for measuring thermal-neutron densities. It has shown that (a) the theory predicts a Poisson distribution for the number of tracks in any given field of observation; (b) this theoretical prediction is fairly well borne out by experiment; (c) when properly put to use, the nuclear-emulsion method is to be counted among the most reliable ones.

539.1.07 : 77

EFFECT OF DEVELOPMENT ON THE STRUCTURE OF TRACKS AND THE FOG IN FINE-GRAIN EMULSIONS. See Abstr. 5188

539.1.07 : 539.1

7258 STATISTICAL ERRORS IN DELAYED COINCIDENCE MEASUREMENTS. A.E.Blaugrund.

Physica, Vol. 25, No. 3, 185-9 (March, 1959).

The statistical error in measurements of lifetimes of excited states of nuclei is calculated. Conditions for minimum error in a delayed coincidence experiment conducted within a fixed time T ar computed. The effect of random coincidences on the statistical error and on the optimal counting conditions is considered. The results are represented graphically.

539.1.0

7259 NUCLEAR SCINTILLATION SPECTROSCOPY AND THE RIDL 100-CHANNEL ANALYSER.

F.De Michelis.

Ric. sci., Vol. 29, No. 8, 1691-5 (Aug., 1959). In Italian.

This paper briefly describes the equipment for nuclear spectroscopy available at the Institute of Experimental Physics, Turin. Attention is focused on the RIDL Type 3300 hundred-channel analyse intended for automatic operation; this unit has a magnetic store and a visual display of the spectrum. Its maximum handling capacity is $1.7 \times \pm 10^6$ counts/sec. A.E.I.Research Laboratory

539.1.07

7260 SCINTILLATION TYPE MASS SPECTROMETER ION DETECTOR. N.R.Daly.

Rec. sci. Instrum, Vol. 31, No. 3, 264-7 (March, 1960).

A new and relatively simple type of mass spectrometer ion detector is described. The positive ion is accelerated onto an aluminium surface releasing secondary electrons, and these in turn are accelerated onto an organic scintillator, viewed by a sealed-off photomultiplier. Counting methods are used to measure the ion beams. The detector has a low noise level, 4×10^{-20} amp, and the mass discrimination is small for ions in the high and low mass range. Admission of air to the vacuum system does not affect the gain of the detector, since no activated surfaces are situated within the vacuum. In the event of a fault occurring in the photomultiplier a new one can be substituted in a few minutes without letting air into the vacuum system.

539.1.07 : 539.12

THE ANALYSIS OF NEUTRON SPECTROMETER RESONANCE DATA. See Abstr. 5571

539.1.07 : 539.1

ON THE ADAPTATION OF AN INTERMEDIATE-IMAGE β-SPECTROMETER TO PAIR SPECTROSCOPY. See Abstr. 5676

539.1.07 : 539.1

METHODS FOR DETECTING AND ANALYSING β- AND γ-RAY POLARIZATION. See Abstr. 5677

NUCLEAR FIELD THEORY

539.1

7261 MATHEMATICAL PROBLEMS OF RELATIVISTIC QUANTUM THEORY. A.S.Wightman.

"Mathematical problems of quantum field theory" Conference, Lille, 1957 (see Abstr. 1237 of 1960) p. 1-38 In French.

Discusses the relevance of the mathematical problems of field theory to physics. Surveys the representations of the inhomogeneo Lorentz group, the axioms of local field theory and of particle theories, the analytic properties of vacuum expectation values and the representations of the canonical commutation relations.

J.Goldstone

539.1

7262 SOME METHODS AND PROBLEMS OF THE QUANTUM THEORY OF INTERACTING FIELDS. L.Van Hove.

"Mathematical problems of quantum field theory" Conference, Lille 1957 (see Abstr. 1237 of 1960) p. 39-55. In French.

Discusses the distinction between bare and physical particles, the adiabatic method and the method of asymptotic states. Summarises results on the application of stationary state perturbation theory to field theory and shows how to construct asymptotic states

J.Goldstone

539.11

7263 A MATHEMATICAL CHARACTERISATION OF OBSERVABLES IN QUANTUM FIELD THEORY AND ITS CONSEQUENCES FOR THE STRUCTURE OF FREE PARTICLES. I.E.Segal.
"Mathematical problems of quantum field theory" Conference, Lille, 1957 (see Abstr. 1237 of 1960) p. 57-103. In French.

Proposes a solution of the mathematical problems of field theory based on defining the particle operators and dynamical operators as generalizations of operators in Hilbert space, viz. as infinitesimal generators of groups of automorphisms of a C* algebra. Gives both mathematical and physical discussion of the statistics and kinematics of bosons and fermions, and of the possibility of treating the dynamics without infinities, and a provisional construction of the fundamental automorphism corresponding to the S-matrix using the fundamental invariant under the symmetry group of the problem corresponding to the interaction Lagrangian. Discusses a possible extension of the symmetry group and its consequences for the theory of elementary particles. J.Goldstone

539.11

7264 QUANTUM ELECTRODYNAMICS. G.Källén.
"Mathematical problems of quantum field theory" Conference, Lille, 1957 (see Abstr. 1237 of 1960) p. 109-17. In French.

Reviews the non-perturbation theory results on the renormalization constants in electrodynamics, and discusses the hypothesis of the validity of the Born approximation at high energies. J.Goldstone

539.11

7265 PERTURBATION SERIES. FIELD EQUATIONS AND THEIR RENORMALIZATION. E.R.Caianiello.
"Mathematical problems of quantum field theory" Conference, Lille, 1957 (see Abstr. 1237 of 1960). p. 119-38. In French.

Reviews results on combinatorial methods of manipulating perturbation series. Presents a method of renormalization based on taking finite parts of integrals in configuration space, which is valid independent of perturbation theory. J.Goldstone

539.11

7266 DISCUSSION OF THE "AXIOMS" AND ASYMPTOTIC PROPERTIES OF A LOCAL FIELD THEORY WITH COMPOSITE PARTICLES. R.Haag.
"Mathematical problems of quantum field theory" Conference, Lille, 1957 (see Abstr. 1237 of 1960) p.151-62. In French.

Presents a set of axioms for local field theory not using the asymptotic condition. This is replaced by an axiom on asymptotic independence of states created by fields in causally separated regions, and it is demonstrated that asymptotic states can then be constructed. J.Goldstone

539.11

7267 MATHEMATICAL PROBLEMS OF QUANTUM FIELD THEORY. [Les problèmes mathématiques de la théorie quantique des champs].
Paris: Centre National de la Recherche Scientifique (1959) 183 pp. [Colloques Internationaux du Centre National de la Recherche Scientifique, No. 75]. In French.

Twelve papers presented at an international conference at Lille, 3-8 June, 1957. Abstracts of the following papers appear above separately as follows. A.S.Wightman (p. 1-38), Mathematical problems of relativistic quantum theory. L.Van Hove (p.39-55), Some methods and problems of the quantum theory of interacting fields. I.E.Segal (p. 57-103), A mathematical characterisation of observables in quantum field theory and its consequences for the structure of free particles. G.Källén (p. 109-17), Quantum electrodynamics. E.R.Caianiello (p. 119-38), Perturbation series, field equations and renormalisation. R.Haag (p. 151-162), Discussion of "axioms" and asymptotic properties of a local field theory with composite particles. The remaining papers were short notes as follows. R.W.Jost (p. 105-7), On the CTP theorem. K.O.Friedrichs (p.139-45), Remarks on the interpretation of functionals in Hilbert space. A.Salam (p.147 (p. 147-9), Relation between scalar and pseudoscalar theories. T.W.Ruijgrok (p.163-8), An exactly renormalisable model of quantum field. H.J.Bremermann, R.Oehme and J.C.Taylor (p.169-78), A possible proof of dispersion relations. J.G.Valatin (p. 179-83), On the divergences in quantum field theory. J.Goldstone

539.11

7268 ON THE INTERPRETATION OF QUANTUM MECHANICS. CASE OF RELATIVISTIC VELOCITY OF A SPINLESS PARTICLE. A.Datzeff.
C.R. Acad. Sci. (Paris), Vol. 250, No. 1, 67-9 (Jan. 4, 1960). In French.

The probabilistic description of the quantized motion of a particle, as developed by the author in previous papers, is extended to include the case when the velocity is comparable with that of light. The Klein—Gordon equation, and the generalization thereof for a charged particle in an electromagnetic field, are recovered. T.R.Carson

539.11

7269 SYMMETRY PROPERTIES OF ELEMENTARY PARTICLES. W.Thirring.
Nuovo Cimento Suppl., Vol. 14, No. 2, 415-28 (1959).

The scalar and unimodular representations of the Lorentz group are introduced, and applied first to a one dimensional problem and then to fields. The connection between spin and statistics is shown to come immediately out of the theory. The concepts of reflections are introduced and the CPT theorem is proved. It is then shown how other symmetry properties, not connected with invariance under the Lorentz group, can be introduced, and examples are given. The question of the number of fields needed to describe a given set of symmetry properties is briefly discussed. E.J.Squires

539.11

7270 GENERALIZATION OF THE PROOF OF DISPERSION RELATIONS. R.Omnès.
C.R. Acad. Sci. (Paris), Vol. 250, No. 7, 1203-5 (Feb. 15, 1960). In French.

An outline is given of a modification of the proof of the dispersion relations for two body collisions in field theory. By directly studying the holomorphy domain of the reaction amplitude without referring to a particular coordinate system, the dispersion relations for fixed momentum transfer are proved for arbitrary masses of the incoming and outgoing particles. R.F.Peierls

539.11

7271 VACUUM POLARIZATION DUE TO CHARGED BOSONS. J.G.Gilson.
Proc. Phys. Soc., Vol. 74, Pt 4, 480-1 (Oct. 1, 1959).

Calculates the lowest-order effect of a charged boson field on the refractive index, using a dispersion relation. R.J.N.Phillips

539.11

7272 ON THE CONSISTENCY OF QUANTIZATION IN QUANTUM ELECTRODYNAMICS. S.Ozaki.
Nuclear Phys., Vol. 15, No. 3, 501-9 (March [1], 1960).

It is shown that the new relativistically covariant quantization method of quantum electrodynamics in the Heisenberg representation leads to a self-consistent and definite formalism. If the electromagnetic 4-potentials are divided into a transverse part, a part related to Coulomb potential, and the remaining indefinite part, which is needed to satisfy identically the fundamental equations when the Lorentz condition is not imposed, the new relativistically covariant quantization determines the commutation relations of the indefinite potential. By transforming the formalism of quantum electrodynamics obtained by the method mentioned above in Heisenberg representation into the interaction representation and determining the interaction Hamiltonian by this procedure, the equivalence to the usual quantum electrodynamics can be proved without any indefiniteness.

539.11

7273 THE TWO-CHARGE RENORMALIZATION GROUP IN SCALAR QUANTUM ELECTRODYNAMICS. V.A.Shakhbazyan.
Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1789-93 (Dec., 1959). In Russian.

The behaviour in the high-momentum region of the single-particle Green's functions and of some asymptotic values of the vertex part and the four-vertex diagram in quantum electrodynamics of zero-spin particles is investigated by the renormalization group procedure.

539.11

7274 ON GAUGE TRANSFORMATIONS IN QUANTUM ELECTRODYNAMICS. Yu.A.Gol'fand.
Zh. eksper. teor. Fiz., Vol. 38, No. 1, 308-9 (Jan., 1960). In Russian.

It is shown that by introducing additional variables into the Hamiltonian, electromagnetic gauge transformations give rise to an infinite manifold of constants of motion. P.Roman

539.11

7275 BOUND STATES IN QUANTUM ELECTRODYNAMICS. T.C.Roy.

Z. Phys., Vol. 158, No. 2, 142-4 (1960).

Defining the unperturbed Hamiltonian so as to give bound states and to commute with the number operator, the physical vacuum can be considered as a zero particle state. W.A.Hepner

539.11

7276 ON A METHOD OF FINDING SINGULARITIES OF FEYNMAN GRAPHS. L.B.Okun and A.P.Rudik.

Nuclear Phys., Vol. 15, No. 2, 261-88 (Feb. (2), 1960).

The method of finding the singularities of Feynman graphs suggested by Landau is investigated. Techniques are evolved to establish whether any Feynman graph has a singularity. If it has, the method under discussion makes it possible easily to determine its location. To illustrate possibilities of the method the singularities of baryon form-factors and the nearest singularities of some simple scattering amplitudes are determined.

539.11

7277 EXTENSION OF THE METHOD OF QUASI-REAL PROCESSES. P.Kessler.

C.R. Acad. Sci. (Paris), Vol. 250, No. 3, 477-9 (Jan. 18, 1960).
In French.

An approximation for Feynman diagrams (Abstr. 1240 of 1960) is extended to treat vertices at which a photon creates a highly relativistic electron—positron pair. R.J.N.Phillips

539.11

7278 APPLICATIONS OF THE METHOD OF QUASI REAL PROCESS. P.Kessler.

C.R.Acad. Sci (Paris), Vol. 250, No. 7, 1200-2 (Feb. 15, 1960).
In French.

Applications of this method to internal conversion in the decay of the μ^+ meson and to pair production in the nucleus field at high energy are given. E.J.Squires

539.11

7279 INTERACTIONS WITH "INVERSION IMAGES" WITH RESPECT TO PM AND CT. K.-H.Tzou.

C.R.Acad. Sci. (Paris), Vol. 250, No. 6, 995-7 (Feb. 8, 1960).
In French.

Previous discussion (Abstr. 5478 of 1960) is extended. R.J.N.Phillips

539.11

7280 EFFECTS OF TWO ADDITIONAL PARTICLES ON THE SYMMETRIES IN STRONG INTERACTIONS. D.B.Lichtenberg.

Phys. Rev. Letters, Vol. 4, No. 3, 143-4 (Feb. 1, 1960).

It is pointed out that if both the particles D ($S = 2$, $I = 0$) and Ω ($S = -3$, $I = 0$), allowed by the Gellman—Nishijima scheme, exist then it is possible to assume the equality of all π—baryon coupling constants, all K—baryon coupling constants and all D—baryon coupling constants without conflicting with any experimental evidence. Further, if the baryons are assumed to have the same bare mass this coupling scheme is compatible with the spectrum splitting into five distinct mass values. E.J.Squires

539.11

7281 UNITARITY CONDITION BELOW PHYSICAL THRESHOLDS IN THE NORMAL AND ANOMALOUS CASES. S.Mandelstam.

Phys. Rev. Letters, Vol. 4, No. 2, 84-7 (Jan. 15, 1960).

Processes such as $\pi + \pi \rightarrow n + \bar{n}$ are considered, for which the physical threshold lies above the threshold for absorption into intermediate states. To calculate the absorptive part below the physical threshold, the Green's function describing the process is considered as an analytic function of the final state particle mass. The actual process is then considered as an analytic continuation in this mass from the point where the physical and absorptive thresholds coincide, and the unitarity condition is valid. The result for the absorptive part is the same as that obtained by applying the unitarity condition directly with the actual mass, below the physical threshold, provided there is no anomalous threshold; the modifications in the latter case are given. R.F.Peierls

539.1

7282 A GENERALIZATION ON THE TENSOR QUANTITIES OF SPIN ½ FIELDS. Kuo-Hsien Tzou.

C.R. Acad. Sci. (Paris), Vol. 250, No. 3, 474-6 (Jan. 18, 1960).
In French.

The tensors, associated with spin ½ fields localized on coordinates related by charge, space time and mass inversions, are deduced. T.R.Carso

539.11

7283 ON A POSSIBLE CONNECTION BETWEEN ISOBARIC SPIN AND STRANGENESS AND INVERSION PROPERTIES OF SPINORS. A.M.Brodsky and D.D.Ivanenko.

Nuclear Phys., Vol. 13, No. 3, 447-50 (Nov. (1), 1959).

Different types of spinor are labelled by indices a, b, α, β which indicate the presence of factors γ_5^a, γ_5^b, i^α, i^β in their trans formation under space and time inversions. From each of these spinors, and their charge conjugates, a pair of self-conjugate spino can be constructed forming an isobaric type doublet. The quantity $N = a - b + \alpha - \beta$ is identified with the baryon number, and $(\alpha - \beta)$ with the strangeness; in this case the association between the break down of parity conservation and strangeness conservation is predicted. Bosons are constructed by combining these spinors. The theory does not include strict baryon number conservation.
R.F.Peierl

539.1

7284 RECOILLESS STRONG COUPLING CHARGED NUCLEON'S PROPAGATOR. L.M.Garrido.

Physica, Vol. 25, No. 6, 472 (June, 1959).

Extends previous work (Abstr. 2076 of 1959), giving another approximation method for the nucleon propagator. R.J.N.Phillip

539.1

7285 FIELD THEORY OF UNSTABLE PARTICLES. J.Schwinger.

Ann. Phys. (New York), Vol. 9, No. 2, 169-93 (Feb., 1960).

Using the example of a spinless boson field, the structure of the simplest Green's function is developed to provide a uniform theory of particles, stable and unstable. Some attention is given to the time decay law of unstable particles and it is emphasized that full account of the relevant physical situation must be contained in its mathematical representation, leading to the conclusion that an essential failure of the exponential decay law marks the limit of applicability of the physical concept of unstable particle. There is a brief discussion of the π and K mesons.

539.

7286 ON THE THEORY OF THE UNSTABLE PARTICLE IN LEE'S MODEL. K.Naito.

Progr. theor. Phys., Vol. 18, No. 2, 200-8 (Aug., 1957).

In Lee's model of the renormalizable field, investigations were made on the possibility of choosing the mass m_V of a physical V-particle to be larger than the sum of the masses of an N- and a θ-particle (namely, the case $m_V > m_N + \mu$). If the mass m_0 of a bare V-particle is chosen to be larger than some particular value, it seems to be possible to describe an unstable V-particle by Lee' model without any inconsistency, and to predict the renormalizatio of such an unstable particle. In this argument a method is used which is somewhat similar to that used in the theory of α-decay. Finally, a brief discussion is given on anomalous states.

539.

7287 A CONTRIBUTION TO THE THEORY OF RELATIVIST CALLY INVARIANT EQUATIONS. L.A.Shelepin.

Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1626-38 (Dec., 1959).
In Russian.

A new method for investigation of group properties of the rela tivistically invariant equations $\alpha_\sigma \partial_\sigma \Psi + \kappa \Psi = 0$ is proposed. The method is based on a study of the properties of an algebra of α-matrices, the so-called U(α)-algebra. Commutation relations between matrices which completely determine the U(α)-algebra can be deduced directly. Structure of the U(α)-algebra and of the associated infinitesimal group ring is studied in detail. The irreducibility conditions are considered. Examples are given of some commutation relations and in particular those which satisfy the Ginzburg and Pauli—Fierz equation. The method proposed lea to substantial simpliciation of the calculations for high-spin partic

539.11

7288 INTEGRAL TRANSFORMATIONS OF THE I.S. SHAPIRO TYPE FOR ZERO-MASS PARTICLES.

L.G.Zastavenko and Chou Guan-chao [Chou Kuang-chao].
Zh. eksper. teor. Fiz., Vol. 38, No. 1, 134-9 (Jan., 1960).
In Russian.

An expansion is presented for a representation according to which the wave-function of a zero-mass and arbitrary-spin particle transforms into irreducible representations of the proper Lorentz group.

539.11

7289 RELATIVISTIC SPHERICAL FUNCTIONS. III.

A.Z.Dolginov and A.N.Moskalev.
Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1697-707 (Dec., 1959).
In Russian.

For previous work see Abstr. 7133 (1956) and 2479 (1960). The wave-function of a particle is expanded in irreducible representations of the Lorentz group. This yields a relativistically invariant classification of the states. The connection between the various modes of realization of the irreducible representations is given.

539.11

7290 MESON—FERMION PV-INTERACTION IN THE THIRRING MODEL.

G.Pócsik.
Acta phys. Hungar., Vol. 11, No. 2, 177-83 (1960).

The PV interaction of a self-coupled massless spinor field and a PS meson field is discussed in one space dimension. It is proved that the field equations are exactly soluble. In the case of an unquantized (external) meson field the model is reducible to the Thirring model (Abstr. 2758 of 1958), but for a quantized meson field one gets the well-known difficulty of PV coupling.

539.11

7291 PROBABILISTICALLY INTERPRETABLE FIELD THEORIES WITH AN INDEFINITE METRIC.

K.L.Nagy.
Acta phys. Hungar., Vol. 11, No. 2, 193-9 (1960).

Methods of constructing "physical" S-matrices are investigated in field theories with an indefinite metric which are not immediately probabilistically interpretable. Procedures are proposed leading to physical S-matrices by means of equations which make possible the probabilistical interpretation for each instant of time. The physical S-matrices thus constructed do not fulfil the causality requirement.

539.11

7292 ANALYTICITY, UNITARITY AND RESONANCES.

B.Bosco.
Nuovo Cimento, Vol. 14, No. 5, 1177-8 (Dec. 1, 1959).

It is shown that the relation $M(E) = M^*(E^*)S(E)$, for $\mathrm{Im}E < 0$, where M is the matrix element for the reaction $\Sigma_i a_i \rightleftharpoons b_1 + b_2$, and S is the scattering matrix of the b particles, which had previously been obtained from dispersion relations, is true under less restrictive conditions than those required to prove the dispersion relations. E.J.Squires

539.11

7293 ON THE CONSTRUCTION OF THE S MATRIX FOR DRESSED PARTICLES.

Yu.Novozhilov.
Nuclear Phys., Vol. 15, No. 3, 469-79 (March [1], 1960).

The problem of setting up the S-matrix for dressed particles is considered by representing the unperturbed states of the dressed particles by means of asymptotic states and by assuming an exponential structure of the vacuum state. Auxiliary independent fields are introduced to describe dressed particles and the scattering theory is formulated in terms of operators and state vectors in the auxiliary field space. The energy operator in the auxiliary field space (effective Hamiltonian) is divided into two parts: the "free" Hamiltonian, whose eigenstates include states of non-interacting dressed particles, and the interaction operator which specifies the particle interaction (but not interaction between the fields).

539.11

7294 ON THE REDUCTION FORMULAE FOR THE S-MATRIX ELEMENTS.

J.Hilgevoord.
Nuclear Phys., Vol. 15, No. 4, 657-63 (March (2), 1960).

Reduction formulae for the S-matrix elements, given by Lehmann, Symanzik and Zimmermann, (Abstr. 1510 of 1955; 8376 of 1957) are derived with particular emphasis on a proper use of the asymtotic condition and on the order of integration, which is not always irrelevant. It is also stressed that local commutativity is not needed for the derivation of most of these formulae.

539.11

7295 AN INTRODUCTION TO DISPERSION RELATIONS.

E.Corinaldesi.
Nuovo Cimento Suppl., Vol. 14, No. 2, 369-84 (1959).

The elementary mathematical results used in the theory of dispersion relations are presented and discussed. The connection of dispersion relations to causality is shown. Appendices discuss the application of dispersion relations to photon—electron scattering and to non-relativistic potential scattering. E.J.Squires

539.11

7296 DISPERSION RELATIONS.

W.Thirring.
Nuovo Cimento Suppl., Vol. 14, No. 2, 385-400 (1959).

An outline of the derivation of dispersion relations for two particle scattering is given, starting from the usual assumptions. The weakness of the original derivations, involving unjustified changes in the order of integrations, is illustrated, and methods whereby this difficulty has been surmounted are indicated. The application of the dispersion relations to the scattering of photons by nucleons and to pion—nucleon scattering is discussed. E.J.Squires

539.11

7297 A NOTE ON DISPERSION RELATIONS.

A.Ramakrishnan, N.R.Ranganathan, R.Vasudevan and S.K.Srinivasan.
Nuclear Phys., Vol. 15, No.3, 516-18 (March [1], 1960).

Dispersion theory is examined on the basis of a reciprocal relationship between the real and imaginary part of the scattering amplitude and it is shown that the knowledge of the absorptive part over the unphysical region leads to a linear integral equation for the dispersive part.

539.11 : 517

DOUBLE DISPERSION RELATIONS. EXISTENCE OF DOUBLE SPECTRAL REPRESENTATION. See Abstr. 6540

539.11

7298 KINEMATICS OF GENERAL SCATTERING PROCESSES AND THE MANDELSTAM REPRESENTATION.

T.W.B.Kibble.
Phys. Rev., Vol. 117, No. 4, 1159-62 (Feb. 15, 1960).

The kinematics of an arbitrary process involving two incoming and two outgoing particles is studied in terms of the invariants used in Mandelstam's representation (Abstr. 4941 of 1959; 1256-7 of 1960), treating the three processes described by the same Green's function simultaneously. It is shown that the physical regions for these processes are bounded by a cubic curve in the plane of the two independent invariants. The unitarity conditions are discussed in the approximation of neglecting intermediate states of more than two particles. The formula for the spectral functions of the double dispersion relation is obtained explicitly in terms of the invariants chosen.

539.11

7299 EQUIVALENT HAMILTONIANS IN SCATTERING THEORY.

H.Ekstein.
Phys. Rev., Vol. 117, No. 6, 1590-5 (March 15, 1960).

This paper is a contribution to the discussion of the question: to what extent does the scattering matrix determine the Hamiltonian? The Hamiltonians considered are nonrelativistic, but in extension of previous studies, "nonlocal" potentials and many-body potentials are allowed. A large class of unitary transformations is found which produce Hamiltonians leading to the same S matrix. In the last section, it is shown that this equivalence is only a special consequence of the general axiomatic formulation of scattering in field theory.

539.11

7300 ON HIGH ENERGY POTENTIAL SCATTERING.

L.M.Garrido and A.G.Tixaire.
Physica, Vol. 25, No. 6, 473-5 (June, 1959).

The use of the effective Green function made by Malenka (Abstr. 9316 of 1954), for small scattering angle is generalized to any angle, introducing the initial and final effective Green functions. Starting from results of Khalatnikov (Abstr. 677 of 1958), Saxon and Schiff's formulae (Abstr. 512 of 1958) and new error estimates are obtained.

539.11 : 539.18

UPPER BOUNDS ON SCATTERING LENGTHS FOR COMPOUND SYSTEMS: n–D̄ QUARTET SCATTERING. See Abstr. 5863

539.11

7301 THE FREDHOLM SOLUTION AS THE LIMIT FOR A SUM OF SEPARABLE POTENTIALS. D.B.Fairlie.

Proc. Cambridge Phil. Soc., Vol. 56, Pt 2, 182-5 (1960).

The scattering amplitude for a potential expressible as a sum of n separable potentials is obtained as the solution of a set of n simultaneous linear equations. As $n \to \infty$ the Fredholm solution for the integral form of the Schrödinger equation is recovered.

539.11

7302 APPLICATION OF THE RAYLEIGH-SCHRÖDINGER PERTURBATION THEORY TO THE DELTA FUNCTION POTENTIAL. S.T.Epstein.

Amer. J. Phys., Vol. 28, No. 5, 495-6 (May, 1960).

Wigner (Abstr. 6815 of 1954) has shown that although there are reasons why one might hope to succeed, one cannot in fact derive the binding energy of the hydrogen atom by second-order perturbation theory applied to a free particle in a box. To further clarify the reasons for this failure the one-dimensional attractive delta function potential is considered.

539.11

7303 QUANTUM STATISTICS OF INTERACTING PARTICLES. II. CLUSTER INTEGRAL DEVELOPMENT OF TRANSPORT COEFFICIENTS. E.W.Montroll and J.C.Ward.

Physica, Vol. 25, No. 6, 423-43 (June, 1959).

For Pt I see abstr. 5665 (1958). A systematic cluster integral expansion has been developed for time relaxed pair distribution functions. Each cluster integral can be represented by a Feynman type diagram in $(r, \beta + it\hbar^{-1})$ space. By employing a formalism due to Kubo such distribution functions are used to obtain cluster integral developments of transport coefficients. The transport coefficients are time integrals over time relaxed momentum correlation functions. Since the time integral of each cluster integral diverges one must sum various sets of cluster integrals before integration. It is shown that in the classical limit summation over one particular set of integrals is equivalent to solving the Boltzmann equation. Irreversability enters naturally into the formalism through the introduction of grand canonical ensemble averages and passage to the limit as the number of particles and volume become infinite in such a way that N/V preserves the proper value for the density.

539.11

7304 QUANTUM THEORY OF INTERACTING BOSONS. E.P.Gross.

Ann. Phys. (New York), Vol. 9, No. 2, 292-324 (Feb., 1960).

Some qualitative features of the ground state of a system of interacting bosons are discussed using wave-functions suggested by the semi-classical theory of boson wave fields. For the case where one deals with weak repulsions, one is lead to a variational extension of Bogolyubov's work. A finite fraction of the N particles occupies the zero-momentum single-particle state, and the dynamic correlations are described by pair excitations. When attractive forces play a decisive role, two cases are found. In one case a finite fraction of the particles occupies a single-particle state, which is now periodic in space. The dynamic correlations are described as a generalization of pair excitations which is different in character for excitation momenta of the order of the inverse of the range of the attractive forces. The single-particle state and dynamic correlations are co-determined in a systematic way. The approximate ground state shows long range order which is destroyed at finite temperatures. A second case where attractions are important is the solid state of the boson system. The ground state has the property that of the order of N orthogonal single-particle states are occupied, each with an average of approximately one particle.

539.11

7305 ON THE STATISTICAL APPROXIMATION OF THE MANY-BODY PROBLEM OF QUANTUM MECHANICS. I. K.Ladányi.

Acta phys. Hungar., Vol. 7, No. 1, 161-6 (1957). In German.

The statistical approximation worked out previously by Macke (Abstr. 93, 938 of 1956) is investigated in the case of an arbitrary number of particles and it is proved that the energy coincides with the customary expression of the energy only if the number of particles is very big.

P.Roman

539.1

7306 MANY-BODY PROBLEM OF A FERMION SYSTEM. I. W.Wild.

Z. Phys., Vol. 158, No. 3, 322-46 (1960). In German.

A fermion system interacting by means of a separable potentia which is not restricted to act only between opposite momenta, is investigated using the Klein—Prange formalism (Abstr. 5372 of 195 The ladder approximation is applied including hole—hole scattering and self-energy terms. It is shown that, even if singularities of the Gottfried type are present, the problem may be treated in a fully consistent way. For weak coupling, the connection with the theory of superconductivity and recent results of Prange is established. The integral equation for the two point function contains terms, whi may be neglected in the weak coupling limit, whose influence for the strong coupling case, however, has not yet been investigates.

537.5

7307 NOTE ON THE DECOMPOSITION RATE IN THE GASEOUS DISCHARGE. S.Hamamura and M.Nishi.

J. Sci. Hiroshima Univ. A. A, Vol. 23, No. 2, 211-14 (Dec., 1959).

The mechanism of decomposition reactions resulting from a glow discharge in a closed system was analysed. Assuming that the decomposition occurred near the cathode and the flowing gas vanished entirely in this region, the fundamental equation of diffusi was solved and the following results were obtained. There exist three regions on the pressure versus time plots, i.e. (1) regions of dp/dt = constant, (2) dumping region, (3) region of dp/dt = kp.

539.1

7308 CLUSTER DEVELOPMENT OF THE DENSITY MATRICES IN THE JASTROW METHOD FOR MANY-FERMION SYSTEMS. S.O.Lundqvist.

Ark. Fys., Vol. 16, Paper 30, 321-8 (1960).

A method is given for the cluster development of the reduced density matrices for Jastrow wave-functions. The essence of the method is to make extensive use of the simple properties of the Dirac density matrices corresponding to the uncorrelated motion, in conjunction with the method of expanding the distribution function for a classical imperfect gas given by Mayer and Montroll.

539.1

7309 THE ERGODIC BEHAVIOUR OF QUANTUM MANY-BODY SYSTEMS. L.van Hove.

Physica, Vol. 25, No. 4, 268-76 (April, 1959).

By a perturbation technique adapted to the actual properties of gases and solids (and possibly also of liquids) it has been establishe in previous papers (Abstr. 7706 of 1955; 8440 of 1957) that under suitable conditions a quantum many-body system approaches statist ical equilibrium as far as those physical quantities are concerned which are diagonal in the unperturbed representation. This result i now extended to non-diagonal quantities of a type broad enough to include all observables of actual interest. A general discussion of the resulting ergodic theorem is given, and its implications for classical statistics are briefly analysed. A recent article by Ingraham (Abstr. 65 of 1959) on the application of the methods to the case of a very small perturbation is discussed. The main arguments of Ingraham are shown to be in error, and the inconsistencies he derives from them are thereby disproved.

539.1

7310 COLLECTIVE MOTION IN MANY-PARTICLE SYSTEMS. I. THE VIOLATION OF CONSERVATION LAWS. H.J.Lipkin.

Ann. Phys. (New York), Vol. 9, 272-91 (Feb., 1960).

A method for treating collective motion is proposed which allows the use of wave-functions violating conservation laws which are valid for the system. The reasons for the use of such wave-functions is discussed and a simple physical interpretation is given The method is illustrated by applications to centre-of-mass motion the electron gas in the random phase approximation, nuclear rotati and the violation of the conservation of the number of particles.

ELEMENTARY PARTICLES

539.12

7311 SEARCH FOR PARTICLES WITH MASSES BETWEEN 6 AND 25 ELECTRON MASSES.
A.S.Belousov, S.V.Rusakov, E.I.Tamm and P.A.Cherenkov.
Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1613-18 (Dec., 1959). In Russian.

Experiments are described to find whether γ-quanta generate particles with masses lying between 6 and 25 electron masses, in accord with the cross-sections predicted by the electromagnetic theory of pair production. For this purpose fast coincidence circuits were employed to measure the time of flight of particles with a given momentum between two scintillation counters. The particles were generated in a lead target placed in the bremsstrahlung beam from a synchrotron. The theoretical coincidence counting rate was compared with the experimental rate obtained with an experimental arrangement designed to record particles with the expected mass. In each set of experiments the ratio of the electron counting rate to the background rate was also measured. The results obtained show that the cross-sections for production of particles with unit charge, spin $\frac{1}{2}$ and masses lying between 6 and 25 m_e are not those predicted by electromagnetic theory.

539.12

7312 NOTE ON THE ISOTOPIC SPIN OF THE ANTIPARTICLE. S.Nakai.
Progr. theor. Phys., Vol. 17, No. 2, 139-44 (Feb., 1957).

Charge conjugation is studied in a different form from the usual one, and the assignments of the eigenvalues of the isotopic spin operator τ_3 for antiprotons and antineutrons are discussed. As an illustrative application, the annihilation process of a nucleon and an antinucleon is dealt with.

539.12

7313 A MODIFICATION OF THE INVARIANT LORENTZ FORMALISM IN THE THEORY OF FUSION.
B.Sredniawa.
Acta phys. Polon., Vol. 16, No. 6, 399-405 (1957). In French.

A modification of de Broglie's theory for the case of two fermions of spin $\frac{1}{2}$ is described. The particles fusing need not be identical. The equations and the tensors are obtained, in a relativistically invariant form, for Dirac particles. A.J.Salmon

539.12

7314 THE THEORY OF THE FUSION OF TWO MAJORANA PARTICLES. B.Sredniawa.
Acta. phys. Polon., Vol. 16, No. 6, 407-414 (1957). In French.

In this paper the relativistically invariant theory of fusion, previously developed by the author, is applied. It is found that the wave functions of the particle, of maximum spin unity, and also the tensors of the Maxwellian and non-Maxwellian fields are real. For the interaction energy between photons and electrons an expression is derived which appears in the semiclassic theory of radiation, instead of the de Broglie expression for complex fields.
A.J.Salmon

Photons

539.12

7315 ANALYSIS OF CASCADE SHOWERS INDUCED BY PHOTONS. M.R.Gupta.
Proc. Nat. Inst. Sci. India A, Vol. 23, No. 4, 217-28 (1957).

The solution of the diffusion equations for a cascade shower initiated by a photon has been obtained and numerical values for both the differential and integral electron spectra have been calculated through saddle-point integration. On the basis of the results obtained, the connection between a photon and an electron-initiated shower has been investigated and comparison with experimental results is also made.

539.12

7316 CALCULATION OF THE UNIFICATION OF TWO PHOTONS OF EQUAL FREQUENCY IN THE PRESENCE OF MATTER BY USING THE KLEIN–GORDON EQUATION.
T.Neugebauer.
Acta phys. Hungar. Vol. 10, No. 2, 221-39 (1959). In German.

The moment induced in a molecule by the vector potential of a light-wave is calculated in the second approximation. The ratio of the intensity of scattering with double frequency to that of Rayleigh scattering is estimated and the most favourable experimental circumstances for verifying the effect are discussed. The selection rules for the new effect are deduced and it is found that the effect does not appear for atoms and symmetric molecules, but may be considerable for completely asymmetric molecules. P.Roman

539.12

7317 A NOTE ON THE RADIATIVE CORRECTIONS TO COMPTON SCATTERING. T.Roy.
Proc. Nat. Inst. Sci. India A, Vol. 22, No. 2, 86-8 (1956).

A study of the various matrix elements that occur in the calculation of the Compton scattering cross-section. Further, following Dyson (1949), the various Feynman graphs are identified with the analytic expressions of Schafroth (1949).

539.12

7318 MONTE CARLO CALCULATIONS OF GAMMA-RAY BACKSCATTERING. M.J.Berger and D.J.Raso.
Radiation Research, Vol. 12, No. 1, 20-37 (Jan., 1960).

Considers the backscattering of γ-rays with energies between 0.02 and 2.0 MeV from hydrogen, water, concrete, iron, tin and lead. The radiation was assumed to be incident on a semi-infinite medium, either isotropically, or at angles of 0° (perpendicular incidence), 30°, 60°, or 90° (grazing incidence). Several thousant photon histories were sampled with the use of an IBM 704 computer to determine the albedo for each case. The information obtained includes (1) the number albedo and energy albedo, (2) the energy distribution of reflected radiation integrated over all directions, (3) the angular distribution of reflected radiation integrated over all energies, (4) the angular distribution of the reflected energy, (5) the average energy of the photons reflected in various directions, and (6) the average obliquity of emergence of the reflected radiation as a function of the γ-ray energy. Tables of albedo and illustrative energy spectra and angular distributions are given. More detailed results can be found in N.B.S. Rep. 5982.

539.12

7319 DISPERSION RELATIONS FOR SCATTERING OF γ-QUANTA ON NUCLEONS.
L.I.Lapidus and Chzhou Guan-Chzhao [Chou Kuang-Chou].
Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1714-21 (Dec., 1959). In Russian.

Dispersion relations for scattering of γ-quanta on nucleons with one subtraction are considered. For forward scattering six relations are obtained which do not contain unknown constants or infrared divergences.

539.12

7320 PRELIMINARY RESULTS ON A SOURCE OF MONOCHROMATIC PHOTONS PRODUCED BY POSITRON ANNIHILATION IN FLIGHT.
J.Miller, C.Schuhl, G.Tamas and C.Tzara.
C.R. Acad. Sci. (Paris), Vol. 249, No. 23, 2543-5 (Dec. 9, 1959). In French.

A preliminary experiment was made to test the design of a monochromatic photon source, using the 30 MeV linear accelerator. The positrons were produced in a platinum target 3 mm thick, then analysed and focused by two simple sector magnets and two pairs of quadrupoles. Annihilation quanta were produced in a lithium target 2 mm thick and detected in a NaI crystal. The yield decreased as expected with increasing energy. It was estimated that using 50 μA of 30 MeV electrons and a positron energy of 21 MeV with 1% dispersion the design source will give 2×10^6 annihilation quanta per sec. A.Ashmore

539.12

7321 THE ABSOLUTE INTENSITY OF THE 2.5 MeV ^{140}La GAMMA-RADIATION. V.A.Arkipov.
J. nuclear Energy, Vol. 8, No. 4, 252-3 (Jan., 1959). English translation of article in: Atomnaya Energiya, Vol. 3, 335 (1957).

The absolute intensity of the 2.5 MeV gamma-ray following the beta (negative) decay of La^{140} is of considerable practical interest. Earlier determinations by other workers of the intensity of this radiation gave the following results: 0.04 quanta/decay by a method which uses the D(γ,p) reaction (Abstr. 5242 of 1950); 0.01-0.1 quanta/decay using the D(γ,n) reaction (Abstr. 1625 of 1947); 0.055 quanta/decay using a gamma-spectrometer. A more accurate value for this quantity using the reaction D(γ,n) was determined as 0.05 quanta/decay, and the method is described.

539.12

7322 NUMERICAL CALCULATION OF ABSOLUTE BREMSSTRAHLUNG INTENSITY FOR A FULLY IONIZED FULLY DISSOCIATED HYDROGENIC GAS.

G.S.Janes and H.Koritz.

J. appl. Phys., Vol. 31, No. 3, 525-8 (March, 1960).

By using the approximate relationships of Kirkpatrick and Weidmann (Abstr. 3029 of 1945) for bremsstrahlung intensities, numerical calculations have been made on the IBM 650 at the Avco–Everett Research Laboratory for a fully ionized, fully dissociated hydrogenic gas. The intensities are given in terms of a quantity having the units ergs/sec.unit frequency interval. steradian.cm^3 as a function of $h\nu$, (from 0.5 to 4.0 eV) and kT (from 4 to 200 eV). A calibration method has been devised for measurement of absolute bremsstrahlung intensities which continually compensates for the errors present in most calibration procedures.

539.12 : 539.2

7323 INTERFERENCE EFFECTS IN HIGH-ENERGY BREMSSTRAHLUNG FROM CRYSTALS. L.I.Schiff.

Phys. Rev., Vol. 117, No. 5, 1394-401 (March 1, 1960).

An attempt is made to understand the negative results of Panofsky and Saxena (Abstr. 12343 of 1959) and the positive results of Frisch and Olson (Abstr. 13537 of 1959) in terms of the theory of the interference effects in high-energy bremsstrahlung from crystals worked out by Uberall (Abstr. 461 of 1957). Several of the theoretical approximations are examined in detail: the validity of the Born approximation, the calculation of temperature effects, the validity of the closure approximation for the crystal lattice, and the use of the Debye form for the lattice vibration spectrum. It is concluded that all of these are justified, except that a partial failure of the Born approximation may be responsible for the nonappearance of the central minimum in the Frisch–Olson experiment. Crystal imperfections and multiple and inelastic scattering of the primary electrons are also considered briefly, but are found to be unimportant. No explanation is found for the Panofsky–Saxena results. The interference should be enhanced by making the primary electron energy as large as possible and the ratio of photon to electron energy as small as possible. In the case of a diamond-type crystal the [110] direction for the electron beam is to be preferred to either the [100] or the [111] direction. Little advantage is to be gained from cooling the crystal.

539.12 : 537.59

7324 EFFECT OF THE MEDIUM DENSITY ON BREMSSTRAHLUNG FROM ELECTRON–PHOTON SHOWERS WITH ENERGIES FROM 10^{11} TO 10^{13} eV.

A.A.Varfolomeev, R.I.Gerasimova, I.I.Gurevich, L.A.Makar'ina, A.S.Romantseva and S.A.Chuyeva.

Zh. eksper. teor. Fiz., Vol. 38, No. 1, 33-45 (Jan., 1960). In Russian.

Examination was made of 15 cosmic-ray electron–photon showers with energies from 10^{11} to 10^{13} eV recorded in emulsion stacks. Energies of primary quanta causing showers were determined by measuring the energy spectrum of cascade electrons at a depth of 2.5-3 radial units, and the screening effect on the first pairs. The energy spectrum of pairs, produced at a depth of 1.5 radial units, was measured. The results obtained agree with the calculations made taking into account the influence of multiple scattering and polarization of the medium on high-energy electron bremsstrahlung.

539.12

7325 CIRCULAR POLARIZATION OF EXTERNAL BREMSSTRAHLUNG FROM β-RAYS IN MAGNETIZED TARGETS. A.Bisi, A.Fasana and L.Zappa.

Nuclear Phys., Vol. 15, No. 2, 231-8 (Feb. (2), 1960).

The degree of circular polarization of the external bremsstrahlung, produced by β-rays from Y^{90} in magnetized targets of silver and annealed Armco iron was investigated. It was found that the polarization is greater when the momentum of the radiating electron is backward with respect to the target magnetization. The ratio of the polarizations corresponding to backward and forward momenta is nearly independent of the quantum energy and equal to 1.33 ± 0.09 (B = 4400 gauss) and 1.53 ± 0.09 (B = 7000 gauss) respectively for Ag and Fe targets. A small effect was also detected by measuring the polarization of the external bremsstrahlung produced in a weakly magnetized iron target, relative to that produced in a highly magnetized target, when the magnetization was perpendicular to the electron momentum. The ratio of the polarizations, not greater than 1.17 and also independent of the quantum energy, appears to be a complicated function of the magnetization. No such effect was detected when silver targets were used under the latter conditions.

539.12 : 539.1

BREMSSTRAHLUNG MONITORING USING THE $Cu^{63}(\gamma,n)Cu^{62}$ REACTION: CORRECTION DUE TO $Cu^{65}(\gamma,3n)$. See Abstr. 5772

539.1

7326 OPTICS OF LIGHT SOURCES MOVING IN REFRACTIV MEDIA. I.M.Frank.

Science, Vol. 131, 702-12 (March 11, 1960).

Nobel prize lecture (1958). An extension of the problem of Cherenkov radiation to the general case of radiation emitted by par icles moving in refractive media at velocities greater than that of light i.e. an account of superlight-velocity optics.

X-rays

539.1

7327 ANGULAR DEPENDENCE OF THE X-RAY BREMSSTRAHLUNG SPECTRUM FROM THICK TARGETS AT 29 MeV.

K.Felbinger, H.Haufglöckner, J.Niemann and M.Scheer.

Naturwissenschaften, Vol. 47, No. 3, 55-6 (1960). In German.

Briefly describes measurements of the distribution of bremsstrahlung from a platinum target in a Betatron operating at 29 MeV. Previous measurements indicated a dependence of X-ray energy or the angle between the incident beam and the detector. This has bee confirmed by measuring Compton scattering over a range of 16-29 MeV at angles of 0° and 2.6° respectively. This must be take into consideration for example in evaluating cross-sections for nuclear photo-emission effects. T.Mulv

539.1

7328 X-RAY ATTENUATION COEFFICIENTS FROM 13 TO 80 MeV FOR HYDROGEN, CARBON, WATER, AND ALUMINUM.

J.M.Wyckoff and H.W.Koch.

Phys. Rev., Vol. 117, No. 5, 1261-74 (March 1, 1960).

These coefficients were measured by placing varying lengths attenuators in a 90 MeV bremsstrahlung beam in a good geometry experiment using a large NaI total-absorption spectrometer as the detector. For hydrogen, a difference method employing cyclohexa (C_6H_{12}) and graphite was used. The theoretical attenuation coefficients were calculated using selected Compton and triplet cross-sections in addition to the small quasi-deuteron cross-sections. A pair cross-section increase of 2.25% was required for carbon, wat and aluminium to bring the total calculated coefficients into agreement with the measured coefficients in the 60 MeV region. The difference between these calculated cross-sections and the measur cross-sections in the 13 to 50 MeV region is ascribed to the giant resonance nuclear absorption. A larger high-energy tail to this absorption than predicted by (γ,p) and (γ,n) experiments is indicate

539.1

7329 VARIATION WITH PARTICLE SIZE OF THE EFFECTIVE X-RAY ABSORPTION COEFFICIENT OF HETEROGENEOUS SLABS.

G.B.Mitre and A.J.C.Wilson.

Brit. J. appl. Phys., Vol. 11, No. 1, 43-5 (Jan., 1960).

The effective absorption coefficient for transmission of X-rays through heterogeneous slabs differs from the weighted-mean absorption coefficient because of random fluctuations in the number of particles of each type of material along different parallel paths. The value of μ_{eff} is calculated for several models; for each it is le than $\langle\mu\rangle$, the difference becoming large for large particles.

539.12 : 523.1

LOW ENERGY X-RAYS FROM INTERPLANETARY SPACE. See Abstr. 6550

539.1

7330 ENERGY AND ANGULAR DISTRIBUTION OF SCATTE RADIATION IN A WATER TANK IRRADIATED BY X-RAYS.

G.Hettinger and N.Starfelt.

Ark. Fys., Vol. 14, Paper 32, 497-511 (1959).

The spectral distribution of scattered X-rays in different directions in a water phantom was studied with the aid of a NaI(Tl) scintillation spectrometer. The primary radiation consisted of heavily filtered X-rays from a commercial X-ray generator with a maximum voltage of 300 kV. The experimentally determined spect differential in energy and angle, were integrated over all angles to give the photon number flux at different primary energies and water depths.

539.12 : 537.52 : 621.387

PRODUCTION OF X-RAYS DURING A LOW-PRESSURE GAS DISCHARGE. See Abstr. 7084

539.12

7331 MICROPROJECTION WITH X-RAYS.

Ong Sing Poen.

Delft : Hoogland en Waltman (1959) 132 pp.

A thesis submitted to the Technical University of Delft, concerning the design and construction of a point-focus X-ray tube and its use for projection microscopy. The physical principles, practical details and present limitations on performance of the instrument are discussed. In order to allow focusing at lower X-ray intensities than give a visible image on a fluorescent screen, a new focusing aid is described. Electrons back-scattered from the focal spot on the target are focused back through the lens system so as to form an image of the spot on the rear of the anode disc, which carries a fluorescent screen. By this means the focal spot can be set at minimum size by visual observation down to very small spot size. The properties of film materials suitable for this type of X-ray microscopy are discussed, and the improved contrast obtained with ultra-fine grained film is experimentally demonstrated. Finally the construction and operation of a new model of X-ray projection microscope is described. The range of voltage is from 5 to 20 kV, four interchangable targets are provided, and the new focusing aid is built in. The volume contains 41 line diagrams, 24 half-tone reproductions and 98 references. V.E.Cosslett

Neutrinos

539.12

7332 ELECTRON AND MUON NEUTRINOS.

B.Pontekorvo [Pontecorvo].

Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1751-7 (Dec., 1959). In Russian.

Some processes due to free neutrinos which heretofore had not been considered are discussed. Special attention is paid to those processes which in principle may help to solve the problem concerning the existence of two neutral lepton pairs: electron pair (ν_e and $\bar{\nu}_e$) and muon pair (ν_μ and $\bar{\nu}_\mu$). To solve the fundamental question whether ν_μ and ν_e are identical particles, a method is proposed which in essence is analogous to the method employed for solving the problem of the distinguishability of the neutrino and antineutrino or K^0 and $\bar{K}^0$ mesons. In principle the problem can be solved if it is demonstrated experimentally that a $\bar{\nu}_\mu$ beam is capable of inducing transitions which $\bar{\nu}_e$ particles can certainly induce (e.g. the $\bar{\nu}_\mu + p \to e^+ + n$ reaction). The experiment suggested above, although difficult, should be feasible with accelerators capable of producing more intense beams than those produced by the present-day accelerators.

Electrons

539.12

7333 ATTEMPT AT A FINITE THEORY OF THE ELECTRON.

O.Bergmann.

Acta Phys. Austriaca, Vol. 13, No. 1, 33-47 (1960). In German.

This is a classical relativistic theory without radiation reaction. W.A.Hepner

539.12

7334 COMMENTS ON FARAGÓ'S TREATMENT OF SPIN PRECESSION IN CROSSED MAGNETIC AND ELECTRIC FIELDS.

V.L.Telegdi and R.Winston.

Proc. Phys. Soc., Vol. 74, Pt 6, 782-6 (Dec., 1959).

The theoretical discussion of a proposed experiment to measure the g-factor of free electrons (Abstr. 5992 of 1959) is criticized and corrected. R.J.N.Phillips

539.12

7335 d-WAVE CONTRIBUTION TO ELECTRON—HYDROGEN ATOM SCATTERING.

R.P.McEachran and P.A.Fraser.

Canad. J. Phys., Vol. 38, No. 2, 317-20 (Feb., 1960).

A numerical solution of the integral equation was made to obtain the s, p, and d contributions to the scattering cross-section for electrons of energy below 13.6 eV, in the exchange approximation. The s and p contributions agreed with previous calculations, and the d contributions were never more than 1%, so could not explain discrepancies between experiment and theory found by Bederson et al. (unpublished report, 1958). J.Hawgood

539.12

7336 ELECTRON—NEUTRINO AND ELECTRON—ANTINEUTRINO SCATTERING.

R.W.King, D.C.Peaslee and J.F.Perkins.

Phys. Rev., Vol. 117, No. 6, 1614 (March 15, 1960)

Cross-sections are given as a function of recoil electron energy, averaged over a reactor spectrum of antineutrinos.

539.12

7337 THE SCATTERING OF FAST CHARGED PARTICLES. VI. THE MULTIPLE SCATTERING OF 10 MeV ELECTRONS AND POSITRONS IN NUCLEAR EMULSIONS.

K.Phillips and C.Ambasankaran.

Proc. Phys. Soc., Vol. 74, Pt 5, 655-9 (Nov., 1959).

For Pt V see Abstr. 5764 (1960). Molière's theory of multiple scattering is checked with 10 MeV electrons and positrons, observed in G5 emulsion. The value of the scattering constant is in good agreement with that deduced from theory. If there is any difference between the multiple scattering of electrons and positrons it is certainly less than 5%. S.J.St-Lorant

539.12

7338 POLARIZATION PHENOMENA IN RADIATIVE COLLISIONS OF TWO ELECTRONS.

V.L.Lyuboshits.

Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1727-40 (Dec., 1959). In Russian.

Two-row matrix formalism is used for the description of polarization phenomena in the collision of two Dirac particles of arbitrary energy. The radiative collision of two polarized electrons is considered. Structure of the general formulae for the polarization parameters after the collision is investigated and concrete calculations are carried out in the ultra-relativistic and non-relativistic limits taking into consideration polarization of the target electrons.

539.12

7339 INVESTIGATION OF DIRECT PAIR PRODUCTION BY ELECTRONS.

L.Criegee.

Z. Phys., Vol. 158, No. 4, 433-43 (1960). In German.

The direct production of electron pairs by 31.5 MeV electrons was investigated. The external electron beam of a betatron, collimated and filtered of photons by deflection, passed through a thin copper foil, and was collected in a Faraday cup. The fast positrons emerging from the foil were analysed in a magnetic field and detected by a plastic scintillator. By varying the thickness of the foil, the differential cross-section for (real) trident production was obtained. It was found to be about one third of the cross-section predicted by Bhabha's theory (Abstr. 5218 of 1935) — with $k = k' = 1$.

539.12

7340 ELECTRON PAIR PRODUCTION AT HIGH ENERGY IN A SILICON SINGLE CRYSTAL.

G.Bologna, G.Diambrini and G.P.Murtas.

Phys. Rev. Letters, Vol. 4, No. 3, 134-5 (Feb. 1, 1960).

Using a pair spectrometer as a detector, the production of electron pairs by the Frascati 1 GeV electron synchrotron γ-ray beam in a single crystal of silicon was measured. The variation with orientation of the crystal was found to be in good agreement with the theoretical calculations of Uberall (Abstr. 461, 7964 of 1957). A.Ashmore

Nucleons

539.12

7341 EFFECT OF A PION—PION SCATTERING RESONANCE ON NUCLEON STRUCTURE. II.

W.R.Frazer and J.R.Fulco.

Phys. Rev., Vol. 117, No. 6, 1609-14 (March 15, 1960).

For Pt I see Abstr. 11358 (1959). It is shown that a resonance of suitable position and width in the $J = 1$, $I = 1$ state of the pion—pion system can bring the dispersion-theoretic calculation of the isotopic-vector part of the nucleon electromagnetic structure into agreement with experiment. The calculation of the isotopic-vector part of the nucleon form factors involves in first approximation the pion form factor and the matrix element for the production by two pions of a nucleon—antinucleon pair. For the pion form factor was used a semiphenomenological solution based on the work of Chew and Mandelstam and involving two parameters related to the position and width of the resonance. For the $\pi + \pi \rightarrow N + N$ amplitude the results of Pt I were used.

539.12

7342 NOTE ON ONE PION EXCHANGE POTENTIAL.

G.Breit and M.H.Hull, Jr.

Nuclear Phys., Vol. 15, No. 2, 216-30 (Feb. [2], 1960).

The phase-parameters of nucleon—nucleon scattering are worked out for the one-pion exchange potential in a way allowing localization of effects in space for each parameter. Success of phenomenologic phase-parameter fits making use of one-pion exchange values for the higher L and J is discussed in terms of the localization. It is shown that the one-pion exchange potential is probably the main interaction at distances greater than 2.9×10^{-13} cm. With somewhat less certainty it is concluded that it is the major interaction for $r > 1.6 \times 10^{-13}$ cm, and evidence is presented for believing that some other interaction is the principal one for $r < 1.6 \times 10^{-13}$ cm.

539.12

7343 COLLISION OF NUCLEONS WITH LARGE ORBITAL MOMENTA.

A.D.Galanin, A.F.Grashin, B.L.Ioffe and I.Ya.Pomeranchuk.

Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1653-79 (Dec., 1959). In Russian.

The part of the nucleon—nucleon scattering amplitude for large orbital momenta $l \gg 1$ which is due to exchange of two mesons is calculated. The connection between this amplitude and scattering of real mesons by nucleons is established by means of the dispersion equations. The method is valid when, apart from the condition $l \gg 1$, the inequality $l\mu/p \gg 1$ is also satisfied (μ is the meson mass, p is the nucleon momentum in the c.m.s.).

539.12

7344 INELASTIC NUCLEON—DEUTERON SCATTERING. I. THE TRANSITION MATRIX IN THE IMPULSE APPROXIMATION FOR GENERAL TWO-BODY INTERACTIONS.

T.Berggren and S.O.Lundqvist.

Ark. Fys., Vol. 16, Paper 13, 153-68 (1959).

Expressions for the transition matrix elements are derived in the impulse approximation, assuming general two-body interactions.

539.12

7345 INELASTIC NUCLEON—DEUTERON SCATTERING. II. PHYSICAL DISCUSSION OF THE IMPULSE APPROXIMATION WITH THE DOUBLE SCATTERING TERMS INCLUDED.

T.Berggren.

Ark. Fys., Vol. 16, Paper 14, 169-80 (1959).

The treatment of inelastic nucleon-deuteron scattering is made more symmetric with respect to the particles in the final state by redefining the transition operator and including the double scattering terms in the impulse approximation. An estimate of the importance of the double scattering terms is made, and it is found that double scattering may be important at all energies, depending on the magnitude of final, rather than initial, relative momenta.

Protons

539.12

7346 POLARIZATION IN PROTON—PROTON SCATTERING NEAR 3.3 MeV.

I.Alexeff and W.Haeberli.

Nuclear Phys., Vol. 15, No. 4, 609-25 (March (2), 1960).

The polarization in proton—proton scattering was measured for energies near 3.3 MeV and scattering angles of $\theta_{c.m.} = 30^{\circ}$, 45°, and 53°. The purpose of the experiment was to remove some of the ambiguities in the proton—proton scattering phase-shifts at low energies. Protons were first scattered from gaseous hydrogen. The scattered protons were then scattered from helium, and the right-left asymmetry was measured by means of two counter telescopes. The gas density of the helium target was increased locally by cooling with liquid air. Corrections on the observed polarization of up to 0.6% were applied to compensate for a number of experimental effects. The following values for the polarization were found: $\theta_{c.m.} = 30^{\circ}$, $P = (0.07 \pm 0.16)\%$; $\theta_{c.m.} = 45^{\circ}$, $P = (0.25 \pm 0.16)\%$; $\theta_{c.m.} = 53^{\circ}$, $P = (0.58 \pm 0.24)\%$. These values are averages of measurements slightly different proton energies. The errors are standard deviations and include all known uncertainties.

539.1

7347 A MEASUREMENT OF THE SPIN CORRELATION COEFFICIENT C_{nn} IN P—P SCATTERING AT 320 MeV FOR 90° CENTRE OF MASS SCATTERING ANGLE.

T.V.Allaby, A.Ashmore, A.N.Diddens and J.Eades.

Proc. Phys. Soc., Vol. 74, Pt 4, 482-3 (Oct. 1, 1959).

By degrading the proton beam energy with a polyethylene absorber near the cyclotron, and modifying the beam collimation, satisfactory experimental conditions were established. The measured asymmetry was $+0.163 \pm 0.016$ to which an estimated geomet rical correction of -0.021 ± 0.005 was made. Using the measured analysing powers of 0.411 ± 0.012 and 0.426 ± 0.012 for the secon scatterings gave $C_{nn} = +0.75 \pm 0.11$. This indicates a preference, though not a significant one, for set 2 of the Berkeley phase shifts.

A.Ashmo

539.

7348 INTERACTIONS OF ANTIPROTONS WITH NUCLEI.

A.Engler, P.B.Jones and J.H.Mulvey.

Proc. Roy. Soc. A, Vol. 254, 425-31 (Feb. 23, 1960).

The energy spectra of charged π-mesons emitted from 377 annihilations of antiprotons in emulsion nuclei have been measure Six charged K-mesons have been observed; this figure correspond to the production of charged K-mesons in $(8 \pm 3)\%$ of annihilation events. Data on the mean free path of interaction of antiprotons with free protons and emulsion nuclei are also presented and are substantial agreement with results obtained previously.

Neutrons

539.

7349 THEORY OF THE β-DECAY OF NEUTRONS.

S.M.Bilen'kii, G.M.Rȳndin, Ya.A.Smorodinskii and Khé Tszo-Syu [Ho Tso-Hsiu].

Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1758-63 (Dec., 1959). In Russian.

Reports calculations of corrections to various effects in the β-decay of neutrons, originated by terms $\sim m/M$ (m and M are the electron and nucleon masses) which are due to the "weak Gell-Mar magnetism" and proton recoil. It is shown that for electron—neutrino correlation and the up-down asymmetry of electrons thes corrections may reach several per cent.

539.

7350 NEUTRON FLUX DISTRIBUTIONS IN MEDIA SEPARA BY A CYLINDRICAL BOUNDARY.

A.E.Glauberman and I.I.Talianskyi.

J. nuclear Energy, Vol. 8, No. 1-3, 84-90 (Nov., 1958). English translation of article in: Atomnaya Energiya, Vol. 3, No. 7, 23 (195

Expressions are derived for the neutron flux distribution due t a point on the axis of cylindrical symmetry of two coaxial media of different properties. The two-group approximation is used, and th transfer of neutrons between the two media is represented by the introduction of fictitious neutron source distributions over the bour ary. Expressions are given for the fast and slow-neutron flux dist butions in both media.

539.1

7351 EXPERIMENTAL TECHNIQUES USING COLD NEUTRONS.

M.Näbauer and F.Schmeissner.

Z. angew. Phys., Vol. 12, No. 3, 133-42 (March, 1960). In German

Reviews work done by using low energy neutrons in conjuncti with low temperature techniques. Topics described and discussed are (i) Neutron reactions using polarized neutron beams and aligne targets. (ii) Production of slow neutrons. (iii) Neutron diffraction liquid helium. (iv) Investigation of magnetic properties of crystall systems. (v) Solid state physics.

R.H.Thom

539.

7352 ELASTIC SCATTERING OF 630 MeV NEUTRONS BY PROTONS.

N.S.Amaglobeli and Yu.M.Kazarinov.

Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1587-93 (Dec., 1959). Russian.

Differential elastic n—p scattering cross-sections $\sigma_{np}(\theta)$ wer measured in the angle range $\theta = 11^\circ$-180° (c.m.s.) for neutrons with a mean energy of 630 MeV. Within the experimental error the data thus obtained are identical with the results of the measurements carried out previously using 580 MeV mean energy neutrons. The dependence $\sigma_{np}(\theta)$ near the angle $\theta = 180^\circ$ was employed to determine the π-meson—nucleon coupling constant by Chew's method and a value $f^2 = 0.06 \pm 0.02$ was obtained.

539.12

7353 THE POLARIZATION IN NEUTRON—PROTON SCATTERING AT 77 MeV.

C.Whitehead, S.Tornabene and G.H.Stafford.
Proc. Phys. Soc., Vol. 75, Pt 3, 345-56 (March, 1960).

A measurement is described of the polarization in neutron—proton scattering at an effective neutron energy of 77 MeV. The beam of polarized neutrons was produced by proton irradiation of a beryllium target. The neutrons emerging at a production angle of 55° were 23.7 ± 1.8% polarized, the beam polarization being measured by using the calculable polarization dependence of small-angle scattering from uranium. In the neutron—proton experiment, an angular range from 20.6° to 159.2° was covered detecting either scattered neutrons or recoil protons. The polarization effects are large and there is a marked difference between the present results and those obtained previously at 95 MeV. A broad neutron spectrum was used extending from 50 MeV but arguments are advanced to establish that the spectrum does not seriously vitiate the validity of the results.

539.12

7354 SCALING NEUTRON TRACKS IN MONTE CARLO SHIELDING CALCULATIONS.

K.W.Morton.
J. nuclear Energy, Vol. 5, No. 3-4, 320-4 (1957).

A simple technique is given to enable neutron tracks in a Monte Carlo study of a given slab of material to be used for slabs of any other thickness. It is applied to the interpretation of some thick sample scattering data.

539.12

7355 TIME-DEPENDENT NEUTRON FLUXES ACCORDING TO MULTIGROUP DIFFUSION THEORY.

A.Y.Özemre.
Nucleonik, Vol. 1, No. 9, 347-51 (Dec., 1959).

Deals with the distribution of time-dependent neutron fluxes in a given multyplying medium according to multigroup diffusion theory. A brief review is given of non-stationary monoenergetic neutron diffusion, followed by an account of the multigroup theory of the non-stationary case. It is found necessary to associate with each root of the critical equation a number of quantities equal to the number of energetic groups; these are refered to as generalized geometrical bucklings. There is an appendix on the problem of reality of the roots of the critical equation. A.J.Salmon

539.12 : 539.17

7356 A NEW MULTIGROUP TREATMENT OF NEUTRON DIFFUSION IN REPRODUCING MEDIA. APPLICATION TO THE CORRECTION OF PERTURBATIONS SUFFERED BY THE THERMAL AND FAST FLUXES IN THE NEIGHBOURHOOD OF A REFLECTOR, A NEUTRON SOURCE, OR A DIFFERENT LATTICE. I. THE COMBINATION $T = \Sigma \frac{1}{3} \lambda_i \phi_i$; EXTENDED TO ALL GROUPS OF NEUTRONS SATISFYING THE DIFFUSION EQUATION $\nabla^2 T + B^2 T = 0$ TO AN APPROXIMATION OF THE SECOND ORDER.

J.Martelly.
J. nuclear Energy, Vol. 8, No. 1-3, 1-9 (Nov., 1958). In French.

If the equilibrium between thermal and fast neutrons propagated in a reproducing medium is perturbed by a neighbouring medium (a reflector, a fast neutron source, a system with a different lattice, etc.) the spatial distribution of each of the groups is also perturbed: it no longer obeys the elementary diffusion equation: $\nabla^2\phi + (K-1)\phi/M^2 = 0$. On the other hand, the linear combination $T = \Sigma \frac{1}{3} \lambda_i \varphi_i$ covering all the neutron groups, no matter how many, is very little affected by these perturbations: this combination satisfies an equation which differs from the above diffusion equation by the addition of corrective terms, modifying the Laplacian, which are proportional to the perturbations of the spectral distribution. Discussion shows that the effect of these corrective terms is negligible in practice for natural uranium lattices; it is also small for enriched piles. A physical interpretation of these results is based on the following statement: the gradient of T is equal to the total neutron current. The introduction of this quantity naturally simplifies certain problems in permitting the use of one group theory (if necessary with slight corrections) to give a better precision than the classical two group theory. In particular the systematic errors in the measurements of the Laplacian, due to the conditions at the extremities of the medium under study are avoided.

539.12 : 539.17

7357 A NEW MULTIGROUP TREATMENT OF NEUTRON DIFFUSION IN REPRODUCING MEDIA. APPLICATION TO THE CORRECTION OF PERTURBATIONS SUFFERED BY THE THERMAL AND FAST FLUXES IN THE NEIGHBOURHOOD OF A REFLECTOR, A NEUTRON SOURCE, OR A DIFFERENT LATTICE. II. PRACTICAL APPLICATION TO THE STUDY OF RESULTS. INTERPRETATION OF MEASUREMENTS, WITH RESONANCE AND THERMAL NEUTRONS, PERTURBED BY THE PROXIMITY OF A REFLECTOR, A SOURCE, OR ANOTHER LATTICE.

J.Martelly.
J. nuclear Energy, Vol. 8, No. 1-3, 9-17 (Nov., 1958). In French.

The practical application of the properties of the function T assumes an experimental knowledge of the function. It is defined for a large number of groups, whereas the actual measurements are often limited to the activities of detectors in the thermal and resonance energy ranges: T can in fact be deduced from them if one knows the diffusion law which applies during slowing down. The calculation is carried through for two particular cases of perturbation – a neighbouring source of fissions, and a neighbouring reflector. The results may be expressed in a two group formula by means of the weighing coefficients, functions of the space co-ordinates – which must be applied to the quantities q_n and q_r which are proportional to the two measured activities. It is more convenient to employ the ratio h of these activities (or, what amounts to the same thing, the "cadmium ratio") since this does not presuppose an absolute calibration of the detectors. T is then expressed by the measure of the thermal flux (q_n) modified by a correction term proportional to the perturbation. The elementary formulae of the one group theory may be conveniently applied to the result of this correction in the order to calculate the Laplacian.

539.12

7358 A VARIATIONAL METHOD FOR THE HOMOGENIZATION OF A HETEROGENEOUS MEDIUM.

L.Trlifaj.
J. nuclear Energy, Vol. 6, No. 1-2, 142-54 (1957). English translation of article in: Atomnaya Energiya, Vol. 2, No. 3, 231 (1957).

The homogenization of a heterogeneous medium is performed by solving a variational problem based on the transport equation for mono-energetic neutrons. It is shown that the values of the constants entering the homogenized problem depend in general on the orientation of the neutron current density relative to the anisotropy of the heterogeneous medium. In the case, however, that the thickness of the layer forming the heterogeneous medium tends to zero, the values of the constants are independent of orientation and are equal to the values for the corresponding homogeneous mixture. This last result disagrees with that obtained by Spinrad (Abstr. 6537 of 1955), who used elementary diffusion theory, while the present work employs transport theory, producing a more accurate result.

539.12

7359 SCATTERING OF THERMAL NEUTRONS IN BERYLLIUM OXIDE.

R.C.Bhandari, L.S.Kothari and K.S.Singwi.
J. nuclear Energy, Vol. 7, No. 1-2, 45-50 (Aug., 1958).

Detailed calculations of the scattering of thermal and cold neutrons, average logarithmic energy decrement, mean energy loss per collision, the slowing-down age and time and the variation of the transport cross-section with energy have been made. The calculated value of the average transport cross-section is in good agreement with the experimental value as deduced from the diffusion length measurement. The agreement between the calculated and the observed total scattering cross-section in the energy range investigated is also very good. However, it is not possible to compare the calculated age with the experimental value, since the former is calculated neglecting absorption.

539.12

7360 SLOWING DOWN OF NEUTRONS IN BERYLLIUM FROM 1.44 eV TO THERMAL ENERGY.

L.S.Kothari and K.S.Singwi.
J. nuclear Energy, Vol. 5, No. 3-4, 342-56 (1957).

The present paper attempts to study the slowing down of neutrons in beryllium in the energy range 1.44 eV to thermal. Taking beryllium temperature to be 300° K, the elastic scattering cross-section as a function of neutron energy and the cross-section for a neutron going, in a single collision, from any given initial energy to any other final energy, are calculated. For neutron energies less than $2k\Theta_D$, Θ_D being the Debye temperature of beryllium and k the

Boltzmann constant, the Debye model of a solid is used; whereas for energies greater than about $2k\Theta_D$ the Einstein model is used. The mean logarithmic energy decrement ξ and the mean energy loss per collision have been evaluated in the two energy regions, and the respective curves are smoothly joined. ξ goes to zero at neutron energy 600k, and the mean energy loss goes to zero around 780k. Assuming that the neutron distribution is very nearly Maxwellian, ξ is averaged over this distribution. As expected, the averaged logarithmic energy decrement $\bar{\xi}$ goes to zero at characteristic temperature $T_0 = 300^\circ$K. Knowing ξ, the slowing-down age is determined as a function of the temperature of the neutron distribution. The time variation of the temperature of the neutron distribution has also been calculated. One finds that it exponentially approaches equilibrium at 296°K, with a relaxation time of 19 μsec. Assuming the distribution to be in equilibrium with the moderator when its temperature is 300°K, one finds that the age from 1.44 eV to thermal is 20 cm^2, and that the time taken by neutrons to slow down in this energy interval is 100 μsec. The total calculated age from fission energy to thermal is 101 cm^2, and the total slowing-down time is 113 μsec.

539.12

7361 SCATTERING OF THERMAL NEUTRONS IN BERYLLIUM. R.C.Bhandari.

J. nuclear Energy, Vol. 6, No. 1-2, 104-12 (1957).

Assuming a Debye frequency spectrum for beryllium and without making use of the incoherent approximation, the elastic and the one-phonon inelastic scattering and transport cross-sections have been calculated as functions of neutron energy. The total calculated scattering cross-section is in good agreement with the experimental values. The average logarithmic energy decrement ξ, and the mean energy-loss per collision have also been calculated as functions of neutron energy and compared with the corresponding values obtained on the basis of the incoherent approximation by Kothari and Singwi (see preceding Abstr.). From the calculated values of the transport cross-section as a function of neutron energy, the mean value of the diffusion coefficient D_0, corresponding to a Maxwell distribution for 300°K, is evaluated. For a beryllium density of 1.78 g/cm^3 the value obtained is 1.26×10^5 cm^2/sec, which agress to within 5% with the experimental value of Antonov et al (1955).

539.12

7362 MEASUREMENT OF THE DIFFUSION LENGTH OF THERMAL NEUTRONS IN ICE.

L.M.Barkov, V.K.Makarin and K.N.Mukhin.

J. nuclear Energy, Vol. 8, No. 1-3, 102 (Nov., 1958). English translation of article in: Atomnaya Energiya, Vol. 3, No. 7, 54 (1957).

The distribution of thermal neutrons in a block of ice 100 cm × × 100 cm × 130 cm has been measured. The thermal neutrons were produced by slowing down neutrons from an Sb—Be source at the centre of the block and the measurements were made by irradiating indium foils in channels cut in the block at various distances from the source ($17.4 \le r \le 31$ cm); the foils were actually irradiated in ice plugs inserted into the channels in order that the presence of the channels would not perturb the neutron distribution. At distances from the source greater than 17 cm, activation by resonance neutrons is less than 0.1% of the total activity, and can be neglected. The experimental methods and the analysis of the results have been described previously (Abstr. 3973 of 1960). The measurements showed that the diffusion length for ice, of density 0.89 ± 0.01 gm/cm^3, at a temperature of -14°C was: $L_i = 2.85 \pm 0.05$ cm.

539.12

7363 THE SLOW-NEUTRON CROSS-SECTION OF GRAPHITE. P.A.Egelstaff.

J. nuclear Energy, Vol. 5, No. 2, 203-9 (1957).

The slow-neutron cross-section of a graphite block has been measured with the direction of extrusion at first parallel to the neutron beam and then at right angles to it. The results are analysed by a new method to find an orientation function for the microcrystals. The magnitude of the orientation effects in the neutron cross-section are about one-quarter those observed in the similar experiment by Arnold, Myers and Weber (1949). The results are also analysed to find the value of the inelastic scattering cross-section.

539.12

7364 MEASUREMENT OF THE MEAN FREE PATH OF NEUTRONS IN GRAPHITE.

Y.Droulers, J.Lacour and V.Raievski.

J. nuclear Energy, Vol. 7, No. 3-4, 210-14 (Sept., 1958). In French

The mean free path of neutrons in graphite was measured by th complex diffusion length method described at the Geneva Conferenc V report P/360 (1955). The anomalies have been explained and eliminated and the precision of the measurements has been increased. The new value obtained is 2.53 ± 0.03 cm for graphite of density 1.6 g cm^{-3}.

539.12 : 539.1

7365 NEUTRON DIFFUSION IN A ONE-DIMENSIONAL URANIUM—WATER LATTICE. Ya.V.Shevelev.

J. nuclear Energy, Vol. 6, No. 1-2, 132-41 (1957). English translation in: Atomnaya Energiya, Vol. 2, No. 3, 224 (1957).

A calculation is performed of the diffusion lengths in a one-dimensional uranium—light-water lattice for thermal neutrons diffusing parallel ($L_{\parallel}$) and perpendicular ($L_{\perp}$) to the infinite slabs of moderator. $L_{\perp}$ is calculated using the diffusion approximation but it appears that this approximation is valid since it applies in both the limiting cases of thick and of thin slabs. $L_{\parallel}$ is calculated usin both diffusion and transport theory; in the latter case, however, it assumed that neutron capture is small. For thick slabs the ratio $(L_{\parallel}{}^2/L_{\perp}{}^2)$ may be as high as 1.9. It is shown that if a uranium—aluminium alloy is used the anisotropy becomes even greater. The anisotropy decreases and tends to zero, with diminishing slab thickness.

539.11

7366 REFLECTION OF FAST NEUTRONS FROM WATER. M.J.Berger and J.W.Cooper.

J. Res. Nat. Bur. Stand., Vol. 63A, No. 2, 101-44 (Sept.-Oct., 1959)

The backscattering of fast (0.3, 1, 3, 6, 9, and 14 MeV) neutron from a semi-infinite water medium has been calculated by the Monte Carlo method. The information obtained includes the joint angular and spectral distribution of the reflected neutrons, the dependence of the number albedo and energy albedo on the source energy and obliquity, and the contributions to the albedo of success orders of scattering. The spectra were calculated down to epithermal energies (~0.5 eV). The results for each case are based o the analysis of 3000 neutron histories, generated with the use of an IBM 704 computer. In the random sampling, elastic scattering fro hydrogen and oxygen, inelastic scattering from oxygen, and absorption due to n—α and n—p processes were taken into account. The cross-sections for some of these interactions are not well-known. Parallel calculations with different assumptions about the cross-sections were made in order to estimate how sensitively the albedo depends on the cross-sections. A self-contained description of the Monte Carlo method, its application to the calculation of radiation diffusion and in particular, to the neutron albedo problem are given Emphasis is placed on the technique of correlated sampling which makes possible an accurate estimate of albedo differences resultin from different assumptions about the cross-sections. The random sampling computations were supplemented by analytical calculation of the single-scattering albedo. This was useful for an understandi of the Monte Carlo results because a considerable fraction of the reflected neutrons return after only one collision.

539.1

7367 THE DIFFUSION COOLING EFFECT IN HEAVY WATE N.G.Sjöstrand.

Ark. Fys., Vol. 15, Paper 11, 145-6 (1959).

An attempt has been made to determine the diffusion paramete of heavy water using the pulsed neutron source method. Two quantities of heavy water were used: 3.68 and 3.14 kg with an H_2O impurity of 0.60 ± 0.10 and 0.75 ± 0.10 per cent by weight respectively. The heavy water was contained in a cylinder 18 cm in diameter, and the experimental arrangement was essentially the same a in earlier work (see Abstr. 1250 of 1955). The temperature of the moderator was 20°C. Measurements were made with different pulse lengths and channel widths and with different detector positio The bucklings for the two geometries were calculated as 0.0864 and 0.0966 cm^{-2}. The measured time constants for the two bucklings were 14640 ± 200 and 16840 ± 400 sec^{-1} from which the diffusion constants for pure D_2O are derived as 1.74 ± 0.06 and 1.80 ± 0.08, both in units of 10^5 cm^2/sec. In order to calculate the diffusion coo ing coefficient c the relation $D = D_0 - (c - d)B^2$, is used where D_0 is the diffusion constant at zero buckling and d is a correction term estimated for heavy water to be 1.3×10^5 cm^4/sec. Using a value of $(2.08 \pm 0.03) \times 10^5$ cm^2/sec for D_0, $c - d$ is found to be $(3.5 \pm 0.8) \times 10^5$ cm^4/sec, and the diffusion cooling coefficient is $(4.8 \pm 1.0) \times 10^5$ cm^4/sec.

539.12

7368 ON THE THEORY UNDERLYING DIFFUSION MEASUREMENTS WITH PULSED NEUTRON SOURCES.

N.G.Sjöstrand.

Ark. Fys., Vol. 15, Paper 12, 147-58 (1959).

Starting from the time-dependent Boltzmann equation some problems relating to measurements with pulsed neutron sources in small geometries are investigated. It is shown that the commonly used formula for the time constant of the fundamental mode of the neutron distribution is only approximate. As a consequence all diffusion cooling coefficients measured up to now are too small by to 30 per cent. Further, the conditions under which the results rom pulsed neutron source measurements in small geometries can be applied to a reactor are given, and the boundary conditions to use in the interpretation of such experiments are discussed.

539.12

7369 ON THE FERMI AGE OF NEUTRONS IN IRON AND STAINLESS STEEL. M.Roos.

J. nuclear Energy, Vol. 7, No. 3-4, 225-7 (Sept., 1959).

539.12

7370 ON NEUTRON MODERATION.

V.V.Smelov.

J. nuclear Energy, Vol. 8, No. 4, 239-41 (Jan., 1959). English translation of article in Atomnaya Energiya, Vol. 3, 317 (1957).

This paper deals with the distribution in space and in energy of neutrons in a monatomic gaseous moderator in the case when the neutron velocities are comparable with the mean thermal velocity of the moderator nuclei.

539.12 : 532.7

LOW-TEMPERATURE NEUTRON MODERATION.

See Abstr. 6795

539.12

7371 ON THE SLOWING DOWN RELAXATION TIME FOR NEUTRONS IN MODERATORS. G.S.Mani.

J. nuclear Energy, Vol. 7, No. 3-4, 220-2 (Sept., 1958).

In a previous paper Iyengar et al., [Proc. Indian Acad. Sci., Vol. 45, No. 4, 215-23 (April, 1957) it had been shown that the slowing down properties of a moderator could be determined from the rate of decay of thermal neutrons to an instantaneous source of fast neutrons. It was assumed in that paper that the transport mean free path of neutrons in the moderator is independent of neutron energy and that the rate of slowing down of neutrons is exponential in time. In this note it is shown that the first assumption may lead to large errors and that the second assumption is not necessary.

539.12

7372 A MONTE CARLO STUDY OF NEUTRON THERMALIZATION. H.D.Brown.

J. nuclear Energy, Vol. 8, No. 4, 177-86 (Jan., 1959).

The slowing down of neutrons from fission to absorption energies in a homogeneous medium has been treated by a Monte Carlo method. Thermalization by elastic collisions in both light and heavy water was computed on an IBM 650. One-sixth the mean-square distance travelled by the neutrons was interpreted as the migration area. This quantity was analysed to give the age, τ, both above and below the indium resonance, and the thermal diffusion constant, D, as functions of the moderator temperature, the effective moderator mass, the moderator composition, the scattering and absorption laws, and the energy distribution of the neutron source. The migration area from the fission energy source to below the indium resonance energy (1.46 eV) was found to be 26.3 cm^2 for H_2O and 115 cm^2 for D_2O. By varying the absorption cross-section, the migration area from the indium resonance energy to absorption of the neutrons could be decomposed into components D/Σ_a and τ_s. D and τ_s were found to be 0.19 cm and 0.77 cm^2 respectively for H_2O, and 0.87 cm and 20 cm^2 for D_2O. D was found to increase with the thermal agitation of the moderator at the rate of 0.13 and 0.14 per cent per deg C for H_2O and D_2O respectively. Neutron energy distributions found from the scattering frequency agree with those derived by analytical methods.

539.12 : 539.17

7373 THE DIFFUSION COOLING OF NEUTRONS IN A FINITE MODERATOR. M.Nelkin.

J. nuclear Energy, Vol. 8, No. 1-3, 48-58 (Nov., 1958).

When a pulse of fast neutrons is thermalized in a finite moderating medium, the asymptotic spectrum at long times is slower than an equilibrium Maxwellian distribution, because of preferential leakage of higher-energy neutrons. This phenomenon of "diffusion-cooling" can be observed by examing the variation of the asymptotic neutron lifetime with the size of the moderating medium. In this paper, the phenomenon is investigated within the context of energy-dependent diffusion theory. A variational expression for the decay constant is formulated and evaluated for trial solutions of Maxwellian form for the neutron spectrum. For small deviations from thermal equilibrium, an expression of the form proposed by von Dardel is obtained. The present relates the diffusion-cooling term in this expression to the energy dependence of the transport mean free path, and to the mean square energy transfer between thermal neutrons and moderator. An analysis of the available experimental results for beryllium, graphite, and water is carried out and yields information on the effects of chemcial binding on the energy transfer between neutrons and moderator. The results for graphite are consistent with the model of Krumhansl and Brooks for the specific heat. The results for beryllium, however, are not consistent with a Debye model which fits the specific heat, and it is suggested that the diffusion cooling is actually smaller than the available experimental value. The analysis for water is less sound theoretically, but it indicates a considerable hindering of the molecular rotations in the liquid.

539.12 : 539.17

7374 DIFFUSION COOLING OF NEUTRONS IN A FINITE SOLID MODERATOR ASSEMBLY.

K.S.Singwi and L.S.Kothari.

J. nuclear Energy, Vol. 8, No. 1-3, 59-62 (Nov., 1958).

Following Nelkin, an expression for the decay constant of the fundamental spatial mode of neutron flux as a function of the buckling of moderating assembly is derived, without making any explicit assumption regarding the variation of transport mean free path λ_{tr} with neutron energy. Numerical results are presented for beryllium, and it is shown that the relation between the diffusion cooling constant and the relaxation time of the last stages of slowing down is a very sensitive function of the variation λ_{tr} with energy; as such it is not possible to estimate the relaxation time by a measurement of the diffusion cooling constant.

539.12

7375 TEMPERATURE DEPENDENCE OF THE EFFECTIVE RESONANCE ABSORPTION INTEGRAL.

I.V.Gordeev, V.V.Orlov and T.Kh.Sedel'nikov.

J. nuclear Energy, Vol. 8, No. 1-3, 162-6 (Nov., 1958). English translation of article in: Atomnaya Energiya, Vol. 3, No. 9, 252 (1957).

539.12

7376 THE EFFECT OF FLUCTUATIONS IN THE REACTION WIDTHS ON RESONANCE INTEGRALS.

E.Kuhn and L.Dresner.

J. nuclear Energy, Vol. 7, No. 1-2, 69-70 (Aug., 1958).

An estimate of the resonance capture integral of non-fissile nuclei previously given has been corrected to include the effect of fluctuations in the neutron width.

539.12

7377 EVALUATION OF THE INTERACTION EFFECT IN N-P CAPTURE. N.Austern and E.Rost.

Phys. Rev., Vol. 117, No. 6, 1506-10 (March 15, 1960).

Recent information about the nuclear force has been used to recalculate the thermal n-p capture cross-section, and a value of 0.303 ± 0.012 b is obtained. The comparison of this number with the experimental cross-section of 0.3315 ± 0.0017 b indicates an "interaction" magnetic dipole moment contribution of 0.028 ± 0.012 b.

539.12

7378 A MEASUREMENT OF THE NEUTRON–PROTON CAPTURE CROSS-SECTION. A.R.Baker.

Proc. Roy. Soc. A, Vol. 246, 539-59 (Dec. 9, 1958).

Measurements have been made of the neutron density as a function of distance from a polonium-beryllium source in effectively infinite tanks of water and aqueous boric acid. The ratio of the thermal-neutron capture cross-sections of boron and hydrogen was found to be 2317 ± 27. The cross-section of hydrogen calculated from this result, using the known cross-section of Harwell standard boron, 769 ± 4 barns (at a neutron velocity of 2200 m/s), and the known cross-section of the boron used relative to Harwell standard boron, 0.985 ± 0.002, was 0.327 ± 0.004 barn (at 2200 m/s) which is consistent with other recent accurate values. In preliminary experiments, it was shown that flux measurements reproducible to better than 3% were possible with the disks of Ilford C2 nuclear research photographic emulsion used as detectors. The main source of error in the result was the statistical error for a total count of 200 000 tracks. The only corrections necessary were 1.6% for recoil proton background, and 0.7% for the disturbance of the neutron density by the detectors.

539.12

7379 NEUTRON SOURCES FROM THE BERYLLIUM REDUCTION OF PLUTONIUM DIOXIDE.

G.G.Michaud and R.R.Boucher.
Canad. J. Phys., Vol. 38, No. 4, 555-64 (April, 1960).

Sintered neutron sources have been prepared by reacting plutonium dioxide with beryllium metal powder. The reaction, forming a plutonium-beryllium alloy, proceeded very slowly at 750° C but was nearly complete at 850° C. Sintered, non-friable agglomerates were obtained by heating the reacted mixtures at 1250 or 1450° C depending on the beryllium concentration. In the composition range of particular interest, i.e. Be/Pu atom ratios of 13:1 and above, the neutron output from the sintered products was from 93 to 98% of the theoretical neutron yield. The presence of BeO in the sinters was found to have negligible effect on the neutron output of the alloy. Studies of some factors affecting neutron output or sinter quality are also reported.

539.12

7380 DEVELOPMENT OF A COMPACT EVACUATED PULSED NEUTRON SOURCE.

J.D.Gow and H.C.Pollock.
Rev. sci. Instrum., Vol. 31, No. 3, 235-40 (March, 1960).

A pulsed neutron source has been developed whose principal element is a sealed-off vacuum tube in which a discharge between titanium tritide surfaces produces tritons, which then are accelerated to a deuterium-loaded target. The construction of a tube producing approximately 10^7 neutrons in microsecond pulses and having a life of several thousand pulses is described.

539.12

7381 COMPACT PULSED GENERATOR OF FAST NEUTRONS.

P.O.Hawkins and R.W.Sutton.
Rev. sci. Instrum., Vol. 31, No. 3, 241-8 (March, 1960).

A study of the factors influencing the design of pulsed neutron generators is made. By using the reaction between tritium and deuterium, peak rates of 10^{13}/sec should be obtainable from quite small sources. A method of keeping the pressure of deuterium gas substantially constant at the working pressure was evolved. This enabled a "sealed-off" and hence portable source to be made. The development of a fast neutron generator or neutron tube based on these considerations is described. This was capable of producing neutrons at a rate of 5×10^{12}/sec at a voltage of 100 kV. The tube was suitable for operation at pulse lengths of 20 μsec, and the neutron content of each pulse was 10^8. No difficulty was experienced in operating at 1 pulse/sec, and higher pulse repetition frequencies may be possible.

539.12

7382 PRESENT STATUS OF NEUTRON SOURCE CALIBRATIONS. K.E.Larsson.

J. nuclear Energy, Vol. 6, No. 4, 322-30 (May, 1958).

During the last three years, six different Ra-Be neutron sources have been compared directly to the Swedish standard Ra-α-Be source, these six sources coming from U.S.A., U.S.S.R., U.K., Switzerland and Belgium. On the basis of this series of direct intercomparisons, a "world" average is defined and it is shown that all the absolute measurements fall within ±2.4% from this average. A survey is given of the absolute measurements included in this direct intercomparison series.

539.12

7383 THE STANDARDIZATION OF NEUTRON SOURCES USING THE GRAPHITE STACK OF A REACTOR.

B.G.Erozolimsky and P.E.Spivak.
J. nuclear Energy, Vol. 6, No. 3, 243-50 (1958). English translation of article in: Atomnaya Energiya, Vol. 2, 327 (1957).

A method of standardizing a neutron source is put forward which involves the comparison, within a graphite stack, of the effect of the source with that of a sink created by introducing an absorber. The apparatus is described, and an account is given of experiments by which the authors, in 1951, calibrated Ra-α-Be and Ra-γ-Be sources to an accuracy of ±3%.

539.1

7384 NEW NEUTRON DETECTOR USING FISSION IN FLOWING GASES. L.Koch.

J. nuclear Energy, Vol. 5, No. 3-4, 357-61 (1957). In French.

Instruments and methods are described with which it is possibl to measure, at any time, a flux of slow neutrons in presence of very intense fluxes of γ-rays: fission products are carried by a gas stream past a β-, γ-counter. The minimum measurable flux is of th order of a few thermal neutrons per cm^2 and per second. The powe of a nuclear reactor can be easily followed; neutron density maps ca be plotted very accurately as soon as fluxes are greater than 10^8 cm^{-2} sec^{-1}. Temperature resistance is excellent.

539.12 : 539.1.0

7385 DISPERSE DETECTORS OF FAST NEUTRONS.

Yu.A.Tsirlin.
Zh. tekh. Fiz., Vol. 29, No. 4, 530 (April, 1959). In Russian. Engli translation in: Soviet Physics—Technical Physics (New York), Vol. No. 4, 472-80 (April, 1959).

Examines a detector which consists of scintillator grains dispersed in a transparent hydrogen-containing medium. A formula is derived for its technical light output, and its efficiency in recording neutrons and γ-rays is evaluated. It is shown that the parameters characterizing the detector (the scintillator concentration, detector thickness) should match one another and the energy of the neutrons or γ-rays.

539.1

7386 A NEUTRON TIME OF FLIGHT SPECTROMETER.

H.Toţia, P.Timiş and C.Lazarovici.
Rev. de Physique (Bucarest), Vol. 4, No. 3, 327-36 (1959). In French.

The detailed circuitry of a 64 channel spectrometer of variabl channel width from 2 to 32 μsec is described. The instrument was completed in 1958 and measurements of the neutron spectrum from a water moderated reactor are presented.

A.E.I. Research Laborator

539.1

7387 THE SLOW CHOPPER AND TIME OF FLIGHT SPECTROMETER IN THEORY AND EXPERIMENT.

K.E.Larsson, U.Dahlborg, S.Holmryd, K.Otnes and R.Stedman.
Ark. Fys., Vol. 16, Paper 19, 199-217 (1959).

The general theory of neutron-chopper time-of-flight spectrometry is reviewed; chopper transmission, resolution and optimum chopper parameters are discussed. The paper then describes the neutron chopper built at Stockholm and used with the reactor R1. The results of resolution measurements and calibration of the time-of-flight time scale are also given.

R.H.Thoma

539.1

7388 NOMOGRAPHS FOR FAST NEUTRON SPECTROSCOPY

E.Bujdoso, L.Medveczky and S.Torok.
Acta phys. Hungar., Vol. 7, No. 3, 373-7 (1957).

A nomograph is described for calculating neutron energy from the microscope data recorded for "knock-on" protons in a nuclear emulsion. The neutron energy range covered is from 0.5 to 14 Me

S.E.Hun

539.1

7389 MEASUREMENTS OF THE ABSOLUTE STRENGTHS OF NEUTRON SOURCES.

V M.Bezotosnii and Yu.S.Zamyatnin.
J. nuclear Energy, Vol. 6, No. 3, 237-42 (1958). English translatio of article in: Atomnaya Energiya, Vol. 2, 313 (1957).

A short account is given of methods of calibrating neutron sources used in various laboratories of the U.S.S.R. Academy of Sciences. A method used by the authors for measuring the absolut intensity of a source is described in detail. This method was deve loped during 1950-51 and is based on a principle suggested by O'Ne and Scharff-Goldhaber (Abstr. 1937 of 1946). Values for the measured intensity of a standard radium-beryllium source, N-23, obtai in various laboratories of the Academy of Sciences are compared. This standard source consisted of a mixture of equal parts of a radium salt with beryllium powder in a container.

539.1

7390 DETERMINATION OF THE INTENSITY OF SHORT-DURATION PULSES OF FAST NEUTRONS.

V.M.Gorbachev and Yu.S.Zamyatnin.
J. nuclear Energy, Vol. 8, No. 1-3, 115-18 (Nov., 1958). English

translation of article in Atomnaya Energiya, Vol. 3, No. 8, 101 (1957).

A method for determining the yield of a pulse of neutrons has been developed. It consists of recording the γ-rays emitted when the neutrons are slowed down and captured in paraffin wax. A sensitivity of 0.1 neutrons/cm^2 has been achieved. Measurements are unaffected by the electrical interference and γ-rays accompanying the production of the neutrons.

Mesons

539.12

7391 MESON PHENOMENA.

S.Fubini.

Nuovo Cimento Suppl., Vol. 14, No. 2, 283-309 (1959).

A review is given of fixed source meson theory. Expressions, in terms of the renormalised coupling constant and the cut-off function, are given for the distribution of the meson cloud in the physical nucleon, and for the p wave meson—nucleon scattering phases. The electromagnetic properties of the nucleon are introduced, and expressions obtained for photoproduction cross-sections.

E.J.Squires

539.12

7392 ANALYTICITY AND UNITARITY IN THE SCATTERING OF SCALAR MESONS ON A STATIC NUCLEON.

B.L.Ioffe.

Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1764-9 (Dec., 1959). In Russian.

Uniqueness of the determination of the scattering amplitude from the analyticity and unitarity conditions is considered for the problem of scattering of scalar neutral and charged mesons on a static nucleon in the one-meson approximation. The analysis is carried out by prescribing analytic properties of the scattering amplitude over the complete Riemann multi-sheeted surface. As a result it is found that the non-uniqueness of the solution may be of the nature of virtual or Breit—Wigner levels.

539.12

7393 PRODUCTION OF MESONS IN NUCLEON—NUCLEON COLLISIONS AND ITS DEPENDENCE ON COLLISION CROSS-SECTIONS.

S.Ganguly.

J. Technol. (Calcutta), Vol. 3, No. 2, 81-91 (Dec., 1958).

Recoil nucleons are taken into consideration, together with the decay of mesons. The results were compared with those of Messel (Abstr. 7253 of 1951) and of Heitler and Janossy (Abstr. 4162 of 1949). The meson intensities have also been calculated.

539.12

7394 ELEMENTARY CONSIDERATIONS ON PHOTO MESON PRODUCTION.

B.Touschek.

Nuovo Cimento Suppl., Vol. 14, No. 2, 278-82 (1959).

The equality (mod π) of the meson nucleon scattering phases and the phases of the meson photoproduction amplitudes is proved. It is shown that a perturbation calculation, including the effect of the anomalous magnetic moment interaction, and corrected for the final pion—nucleon interaction in the 3/2, 3/2state, gives reasonable agreement with the experimental data. E.J.Squires

539.12

7395 HYDRODYNAMICAL TREATMENT OF MULTIPLE MESON PRODUCTION IN HIGH ENERGY NUCLEON—NUCLEUS COLLISIONS.

S.Amai, H.Fukuda, G.Iso and M.Sato.

Progr. theor. Phys., Vol. 17, No. 2, 241-87 (Feb., 1957).

The multiple meson production in high energy nucleon—nucleus collisions is treated by extending Landau's hydrodynamical model which is supported not only from experimental data on cosmic rays, but also from some theoretical points of view. More data on the nucleon—nucleus collisions is available, rather than on elementary collisions and the trend of future theory is predicted by comparing the results with the data on cosmic rays, though the latter are very complicated and this theory is somewhat phenomenological. Theoretical results are derived focusing on the dynamical properties of secondary particles, such as the effective inelasticity, energy and angular distributions and transverse momenta; and their dependence on the size of the nucleus is considered.

539.12

7396 NOTE ON MODELS OF MULTIPLE MESON PRODUCTION AT EXTREMELY HIGH ENERGY.

Z.Koba.

Progr. theor. Phys., Vol. 17, No. 2, 288-302 (Feb., 1957).

Takagi's model and Heisenberg's model (modified with regard to the total cross-section) for multiple meson production are examined, and they are found to conform to two sources of experimental information on the properties of secondary particles in jet showers: their composition and the distribution of their transverse momenta. The main aspects of these models, as well as those of the Landau model, are discussed.

539.12

7397 MIXED NUCLEON—MESON CASCADES IN FINITE ABSORBERS.

S.Ganguly.

Proc. Nat. Inst. Sci. India A, Vol. 22, No. 1, 40-53 (1956).

Nucleon—nucleon collisons produce mesons and recoil nucleons. The recoil nucleons as also the mesons are capable of staring new showers. The cross-sections used by Messel, Potts and McCusker (Abstr. 9039 of 1952) have been used in the estimation of the showers and the decay of mesons has been taken into account. The diffusion equations have been solved and their solutions have been obtained in a form suitable for numerical computations. Numerical results have been obtained for the energy spectra of nucleons and mesons at different depths. The large effect produced by the decay of mesons on the formation of the shower is clear from a comparison of the sizes of showers in heavy and light elements.

539.12

7398 THE PROBLEM OF THE "ANOMALOUS" MASS OF MUONS.

G.Marx and K.L.Nagy.

Acta phys. Hungar., Vol. 11, No. 2, 161-76 (1960).

It is supposed that there exists an intermediately strong interaction between muons and kaons having the same form as that between nucleons and kaons. This interaction explains the relatively large mass of muons. After fixing the values of the parameters appearing in the interaction, other observable consequences, e.g. elastic and inelastic muon—nucleon scattering, anomalous muon magnetic moment etc., are analysed. These "anomalous" effects caused by the supposed interaction turn out to be small and thus do not seem to contradict the present experimental facts. Other kaonic interactions are briefly analysed.

539.12

7399 ANOMALOUS SCATTERING OF LOW ENERGY MU-MESONS IN COPPER.

N.Basu and M.S.Sinha.

Proc. Nat. Inst. Sci. India A, Vol. 24, No. 5, 295-303 (1958).

By a special arrangement of a three-fold coincidence and anti-coincidence system, an ϵ cloud chamber fitted with five $\frac{1}{2}$ in. copper plates has been triggered to photograph tracks of particles stopped inside the chamber. From a total number of about 800 such pictures 250 were selected in which the ionization in the different gaps and residual range definitely identified the particles as μ-mesons. These muons had momenta varying from 100-170 MeV/s when they entered the chamber. The projected angle of scattering of each Cu-plate was measured together with the momentum of the muons from the residual range and ionization after the scattering. Altogether 446 scattering angles of muons with their momenta was analysed and a differential distribution of $p\beta\theta$ have been obtained. It has been found that the distribution agrees well with the theory of other authors e.g. (Abstr. 7355 of 1952; 609, 6262 of 1949) up to $p\beta\theta = 2.5$, and is too large by a factor of 2 to 3 for values of $p\beta\theta = 3$ to 5. The disagreement is observed to be much more prominent in the low energy region that that reported by other workers for the high energy muons.

539.12

7400 ANGULAR DISTRIBUTION OF RECOILS FROM MU-MESON CAPTURE.

M.E.Rose and R.H.Good, Jr.

Ann. Phys. (New York), Vol. 9, No. 2, 211-19 (Feb., 1960).

It is pointed out that direct evidence bearing on the four fermion interaction in μ-capture can be obtained by measuring the angular distribution of recoils relative to the μ-polarization. The existence of an anisotropy implies parity and charge conjugation breakdown. The sign of the anisotropy coefficient yields directly the relative helicities of neutrino and μ-meson at creation. The angular distribution is calculated for $0 \rightarrow J$ transitions with parity change $(-)^{J+1}$ since this description corresponds to the most practical possibilities: capture in C^{12} and O^{16}. The anisotropy coefficient is αP where $P \cong 0.15$ is the μ-polarization and $-\alpha$ varies between 0.40 and 0.80

for C (between 0.22 and 0.73 for O) depending on the presumed existence of effective pseudoscalar and conserved vector current contributions to the interaction Hamiltonian.

539.12 : 537.59

POLARIZATION OF COSMIC-RAY μ^+-MESONS IN THE HIGH-ENERGY REGION. See Abstr. 7441

539.12

7401 LOW ENERGY PION PHYSICS.
J.M.Cassels.

Nuovo Cimento Suppl., Vol. 14, No. 2, 259-77 (1959).

The low energy (s wave) interactions between pions, nucleons and photons are discussed. It is shown how the spin and parity of the pion can be obtained from experimental data. Relations between the various interaction rates are deduced on the basis of charge independence and detailed balancing, and it is shown that the latest experimental data is compatible with these relations. The present situation in the experimental and theoretical determination of the energy shifts in π-mesonic atoms is also discussed.

E.J.Squires

539.12

7402 β-DECAY OF NEGATIVE PIONS.
Yu.A.Budagov, S.Wiktor, V.P.Dzhelepov, P.F.Yermolov and V.I.Moskalev.

Nuclear Phys., Vol. 14, No. 2, 339-41 (Dec. (2), 1959).

Triple scanning of 100 000 stereo pairs of diffusion cloud chamber photographs showing tracks of π^- mesons has yielded 3 examples identified as $\pi^- \to e^-$ decays. This gives for the ratio to normal decays $(1.2 \pm 0.7) \times 10^{-4}$ which agrees with the value for positive mesons, and with predictions of the V-A theory of β-decay.

S.J.Goldsack

539.12

7403 ELECTROMAGNETIC PROPERTIES OF π AND K MESONS. K.Tanaka.

Phys. Rev., Vol. 117, No. 5, 1403-6 (March 1, 1960).

A formalism is proposed which can give a smaller mass for the charged than for the neutral K meson, but a larger mass for the charged than for the neutral π meson. The theoretical prediction agrees with the experimental mass difference $M(K^0) - M(K^+) \cong 9.4$ electron masses if the r.m.s. radius of the charge distribution of the K meson is equal to 0.48×10^{-13} cm.

539.12

7404 PARTIAL-WAVE DISPERSION RELATIONS FOR THE PROCESS $\pi + \pi \to N + \bar{N}$. W.R.Frazer and J.R.Fulco.

Phys. Rev., Vol. 117, No. 6, 1603-8 (March 15, 1960).

The problems of pion–nucleon and nucleon–nucleon scattering and nucleon electromagnetic structure involve the matrix element for two pions producing a nucleon–antinucleon pair. By use of the Mandelstam representation one can write dispersion relations for the partial-wave scattering amplitudes of this process. In the low energy range these dispersion relations can be transformed into integral equations whose kernels are simply related to pion–nucleon and pion–pion scattering amplitudes.

539.12

7405 THREE PION RESONANCE OR BOUND STATE.
G.F.Chew.

Phys. Rev. Letters, Vol. 4, No. 3, 142-3 (Feb. 1, 1960).

In a three pion state, with $T = 0$, $J = 1$ and odd parity, each pair is in a pure $T = 1$ state and, at low energy, mainly in an $l = 1$ state. Thus the strong attraction in this state might well give rise to either a resonance or bound state with mass less than $3m_\pi$. Suggestions for observing the resonance or bound state are discussed.

E.J.Squires

539.12

7406 FIT TO DISPERSION RELATIONS OF PION–NUCLEON SCATTERING. G.Puppi.

Nuovo Cimento Suppl., Vol. 14, No. 2, 401-7 (1959).

It is shown how pion–nucleon dispersion relations have been used to give the sign of the phase shifts, to resolve the Fermi–Yang ambiguity, and to determine a value of the pion–nucleon coupling constant. The possibility of a disagreement between the predicted and experimental results on negative pion–proton scattering is discussed, and it is shown that this discrepancy is being removed by improved data.

E.J.Squires

539.1

7407 CHARGE-DEPENDENT CORRECTIONS TO PION–NUCLEON SCATTERING. D.M.Greenberger.

Phys. Rev., Vol. 117, No. 5, 1378-93 (March 1, 1960).

If account is taken of the mass difference between neutral and charged pions and of the possibility that the three coupling constan (π^0–n, π^0–p, $\pi^\pm$–nucleon) may differ, then the pion–nucleon syste no longer conserves isotopic spin. This effect has been investigate using Chew–Low theory with a p-state interaction. For each J val there are ten scattering amplitudes, replacing the two of the charg independent case. Only eight of these amplitudes are independent due to time reversal invariance, and the mass difference effect ca be related to a change in the energy scale. The amplitudes are determined as solutions to a set of linear integral equations which may be solved approximately in the one-meson approximation. Corrections to the differential cross-sections are then calculated. These corrections go through a maximum at about 125 MeV and ca affect the magnitude of the π^- cross-sections by as much as 35% i this region, as well as the slope of the π^- cross-section in the regi 125-175 MeV. The effect on the π^+ cross-section is small. Attem are made to correlate the calculation with available data.

539.1

7408 NON-ELASTIC COLLISIONS OF FAST π-MESONS WITH NUCLEONS AND PERIPHERAL ($\pi\pi$) INTERACTI
V.S.Barashenkov.

Nuclear Phys., Vol. 15, No. 3, 486-94 (March[1], 1960).

A model of central and peripheral pion–nucleon collisions is discussed on the basis of (π^-p)-collisions at E = 5 GeV. The asymmetry of angular distribution of produced particles observed in experiments may be explained on the assumption that the cross-secti of peripheral collisions constitutes $>\sim$ 20% of the total cross-sectio of (π^-p) collisions. An estimate $\sigma_{\pi\pi} \approx \sigma_{\pi N}$ is obtained for the cross-section of ($\pi\pi$) interactions at $E > \sim 1$ GeV. Angular asymmetry of strange particles produced in (π^-p) collisions is discussed.

539.1

7409 ELASTIC SCATTERING OF 390 MeV π^+-MESONS BY PROTONS. E.L.Grivor'ev and N.A.Mitin.

Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1583-6 (Dec., 1959). In Russian.

The angular distribution of (390 ± 25) MeV π^+-mesons elastically scattered on hydrogen was measured using nuclear emulsions A formula for the differential scattering cross-section is given. Phase shifts of the Fermi solution obtained by assuming that only S- and P-states participate in scattering are $\alpha_3 = -34^0$, $\alpha_{33} = 151^0$ and $\alpha_{31} = -16^0$.

539.1

7410 PHOTOPRODUCTION OF NEUTRAL PIONS AT FORWARD ANGLES. K.Berkelman and J.A.Waggoner.

Phys. Rev., Vol. 117, No. 5, 1364-75 (March 1, 1960).

The bremsstrahlung beam of the Cornell BeV electron synchrotron was used to study the reaction $\gamma + p \to \pi^0 + p$ over the photon energy range 250 MeV to 1 GeV, and for centre-of-mass pion angle between 20^0 and 70^0. The recoil protons, of energies between 10 an 60 MeV, were identified and their energies determined using a rang telescope of eight thin plastic scintillators enclosed in a vacuum chamber with the thin liquid hydrogen target. Correlated pulse-height information was obtained by photographing an oscilloscope display and was used to sort out the protons from mesons and electrons. Corrections were made for the background of photoprotons from the Mylar target cup, the energy loss of the protons in the liqu hydrogen, absorption and scattering in the counter telescope, and th variation of beam intensity profile with energy. Compared with previous experiments and extrapolations the results show a somewhat smaller forward differential cross-section above 400 MeV. T angular distributions obtained from a least-squares fit to all existi data indicate a $d_{3/2}$ assignment for the 760 MeV resonance level. Other implications of the data are also discussed.

539.1

7411 SELECTION RULES IN THE ONE K MESON THEORY.
G.Marx.

Acta. phys. Hungar., Vol. 7, No. 1, 469-72 (1957).

Selection rules in the production and decay of K-mesons are discussed and examples given.

C.J.Batt

539.1

7412 NEW TEST FOR $\Delta I = \frac{1}{2}$ IN K^+ DECAY.
S.Weinberg.

Phys. Rev. Letters, Vol. 4, No. 2, 87-9 (Jan. 15, 1960).

The two decay modes, τ and τ', of the K^+ meson are compared, in their dependence on the kinetic energies of the three emerging pions in each case. By examining the restrictions imposed by assuming different values for the total isotopic spin, criteria are given for detecting the presence of $\Delta I = 3/2, 5/2$, or $\Delta I = 5/2, 7/2$ terms by studying the distribution of the events in the Dalitz–Fabri plot. An approximate prediction for the energy spectrum of the π^+ from τ' decay is given, assuming that $\Delta I = \frac{1}{2}$, in terms of the observed π^- spectrum in τ decay. R.F.Peierls

539.12

7413 $\Delta T = \frac{1}{2}$ SELECTION RULE AND $K^+_{2\pi}$ DECAY.
M.L.Good and W.G.Holladay.

Phys. Rev. Letters, Vol. 4, No. 3, 138-9 (Feb. 1, 1960).

If the $\Delta T = \frac{1}{2}$ selection rule for weak decays is assumed to be exact, the $K \to \pi^+ + \pi^0$ decay can only be explained by including electromagnetic effects. Simple estimates suggest that these are too small, but it is pointed out that a recently proposed strong interaction between pions in the T = 2, J = O state can give sufficient enhancement to explain the observed rate, provided the range of this interaction is sufficiently small. E.J.Squires

539.12

7414 THE K_{e_4} DECAY.
L.B.Okun' and E.P.Shabalin.

Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1775-80 (Dec., 1959). In Russian.

The probabilities of K_{e_4} decays ($K \to e + \nu + 2\Pi$) are computed. The selection rules and the isotopic relations between various K_{e_4} decays are determined on the basis of the Sakata model.

539.12

7415 THEORY OF K^+–NUCLEON SCATTERING.
I.R.Gatland.

Nuclear Phys., Vol. 15, No. 3, 480-5 (March [1],1960).

Dispersion relations for the K–N interaction show that the "Born" term is dominant in K^+–p scattering. Therefore the cross-section and angular distribution for K^+–p scattering were calculated by perturbation theory using the lowest-order Feynman graphs and, given certain parities and coupling constants, this fits the experimental data. The theory does not give good results for K^+–n scattering.

539.12

7416 OPTICAL MODEL POTENTIAL FOR K^- MESONS.
M.Melkanoff, D.J.Prowse and D.H.Stork.

Phys. Rev. Letters, Vol. 4, No. 4, 183-5 (Feb. 15, 1960).

Experimental results of K^- scattering on nuclei of photographic emulsions between 95 and 125 MeV, are analysed on the basis of an optical model using a Saxon-type potential. It is shown that a fit is possible for a wide range of values of the parameters, but that for most of these the real part of the potential must be chosen to be attractive. S.J.Goldsack

Hyperons

539.12

7417 EXPERIMENTAL EVIDENCE FOR THE DECAY MODE $\Sigma^+ \to p + \gamma$.
G.Quareni, A.Q.Vignudelli, G.Dascola and S.Mora.

Nuovo Cimento, Vol. 14, No. 5, 1179-80 (Dec. 1, 1959).

Three events are described in which particles emitted during capture of K^- subsequently decay with the emission of a stable particle, which could be a proton. The energy of the proton is in each case consistent with that expected for γ-decay of a Σ^+ hyperon. S.J.Goldsack

539.12

7418 DETERMINATION OF (Σ,K) RELATIVE PARITY.
W.M.Frank, I.Goldberg and R.M.Rockmore.

Phys. Rev., Vol. 117, No. 5, 1402-3 (March 1, 1960).

Different relative parity assignments are shown to lead to distinguishable angular distributions in the $K^+ + K^+ + \bar{K}^0$ annihilation mode of unpolarized ($\bar{\Sigma}^-$,p) systems. An impact parameter argument is used to limit consideration to the two cases $\lambda, l = 0,1$ and $\lambda, l = 0,1,2$, where λ denotes the relative angular momentum of the $2K^+$ system and l, that of the $\bar{K}^0$ with respect to the centre of mass of the $2K^+$ system.

539.12

7419 STRANGENESS OF THE CASCADE HYPERON Ξ^-.
D.J.Prowse.

Phys. Rev. Letters, Vol. 4, No. 4, 188-90 (Feb. 15, 1960).

An event is described which is interpreted as an example of the process $K^- + p \to K^+ + \Xi^-$. This process can conserve strangeness only if that of the Ξ^- particle is -2, as has usually been assumed. S.J.Goldsack

Strange particles

539.12

7420 SOME ASPECTS OF THE PROBLEM OF THE HEAVY UNSTABLE PARTICLES. N.Dallaporta.

Acta phys. Austriaca, Vol. 13, No. 1, 19-32 (1960).

This lecture, delivered in March 1958, summarizes the main points regarding the observations on strange particles up to that date and the problems which remain to be investigated to obtain a preliminary general picture of the situation. P.K.Kabir

Deuterons

539.12 : 539.11

7421 RELATIVISTIC DEUTERON WAVE FUNCTION. I.
M.Gourdin and J.Tran Thanh Van.

Nuovo Cimento, Vol. 14, No. 5, 1051-64 (Dec. 1, 1959).

The Bethe–Salpeter equation for two spinless particles, interacting through a scalar meson field, is considered. A partial wave method developed previously (Abstr. 338 of 1960) is used. A bound state wave-function is found, after some approximations, and is compared with the Hulthén wave-function; the differences, attributed to relativistic effects, suggest a short-range repulsion. R.J.N.Phillips

539.12

7422 ON THE MEASUREMENT OF DEUTERON POLARIZATION. R.J.N.Phillips.

Proc. Phys. Soc., Vol. 75, Pt 2, 317-19 (Feb., 1960).

When unpolarized deuterons are scattered from spinless nuclei, their final polarization involves four parameters. It is shown that the latter may be found by double-scattering measurements, for a light nucleus which can itself be used as projectile. Double-scattering is not enough for heavy nuclei, however, unless a previously calibrated polarizer or analyzer is available, or magnetic spin precession is used. R.J.N.Phillips

539.12

7423 HYDROGEN-HELIUM ISOTOPE ELASTIC SCATTERING PROCESSES AT INTERMEDIATE ENERGIES.
J.E.Brolley, Jr, T.M.Putnam, L.Rosen and L.Stewart.

Phys. Rev., Vol. 117, No. 5, 1307-17 (March 1, 1960).

Differential cross-sections for the elastic scattering of various hydrogen and helium isotopes were measured using accelerated particles from the Los Alamos 42 in. cyclotron. The scattering of protons and deuterons from deuterons, tritons, and He^3 particles was studied over an energy range of 5 to 14 MeV. The elastic scattering of ~ 10 MeV polarized protons was also studied. In all cases nuclear emulsions were used as detectors. Proton–deuteron elastic scattering was measured at 5.6 and 7.85 MeV. A comparison is made to results at nearby energies of both p–D and n–D scattering and to theoretical predictions. The scattering of 10 MeV polarized protons from deuterons was measured and provides support for calculations using central force approximations. Measurements of p–T and p–He^3 elastic scattering at 6.5 and 8.34 MeV give angular distributions which are quite similar to those for p–D and p–He^3. An encouraging agreement is found with resonating-group calculations with central-force approximations of the Serber type. Deuteron–deuteron scattering was measured at 6.0, 8.2, 12.1, and 13.8 MeV. A preliminary theoretical treatment indicates that the process is predominantly hard-sphere scattering with no strong level-splitting. Deuteron–triton and d–He^3 scattering was measured over the energy range of 5 to 14 MeV. The results for the two processes are almost indistinguishable at the present level of accuracy.

539.12

7424 THEORY OF THE PHOTODISINTEGRATION OF THE DEUTERON AND n—p CAPTURE. J.J. de Swart.
Physica, Vol. 25, No. 4, 233-50 (April, 1959).

The photodisintegration of the deuteron and the n—p capture in the medium energy range is investigated by considering the final state interactions including tensor coupling exactly. The electric transitions are treated in all multipole orders, assuming the validity of the Siegert theorem. Of the magnetic transitions, only the magnetic dipole spin flip transition is taken into account. For the photodisintegration, the angular distribution and polarization of the outgoing nucleons are given for arbitrary polarized radiation. In the n—p capture, the angular distribution and polarization of the γ-rays are given for an arbitrarily polarized neutron beam. The formulae are specialized for E1, E2 and M1 spin flip transitions.

Tritons

539.12

7425 ENERGY DISTRIBUTION OF REACTION PRODUCTS WITH RECOIL OF SOME PARTICLES.
V.V.Komarov and A.M.Popova.
Zh. eksper. teor. Fiz., Vol. 38, No. 1, 253-5 (Jan., 1960).
In Russian.

The reaction $T + d \rightarrow He^3 + n + n$ was studied using 12 MeV deuterons, and the energy distributions for He^3 recoil plotted for two angles: 25° and 75° to the incident beam. Although the scatter of the experimental results is rather large, there is unambiguous evidence for two energy peaks at each angle; these occur at approximately 0.9 MeV and 1.6 MeV for $\varphi = 25°$, and at 0.6 MeV and 1.2 MeV for $\varphi = 75°$. J.W.Gardner

Alpha-particles

539.12

7426 ON THE PHOTODISINTEGRATION OF THREE-PARTICLE NUCLEI. C.Rossetti.
Nuovo Cimento, Vol. 14, No. 5, 1171-3 (Dec. 1, 1959).

The total cross-sections of the reactions $He^3(\gamma, p)d$ and $H^3(\gamma, n)d$ were calculated as functions of energy just above threshold. Direct interaction formalism was used, and only electric-dipole absorption was included. Nuclear size is seen to have a strong effect on the results, and this fact provides the possibility of obtaining information about the former. J.A.Evans

COSMIC RAYS

(Nuclear reactions due to cosmic rays are included under Nuclear Reactions)

537.59

7427 PROCEEDINGS OF THE MOSCOW COSMIC RAY CONFERENCE [English Edition].
VOL. I. NUCLEAR INTERACTIONS AT ENERGIES FROM 10^{11} TO 10^{14} eV. 52 papers, 333 pp.
VOL. II. EXTENSIVE AIR SHOWERS AND CASCADE PROCESSES. 55 papers, 332 pp.
VOL. III. THE EARTH RADIATION BELTS. 40 papers, 253 pp.
VOL. IV. VARIATIONS OF COSMIC-RAY INTENSITY. 54 papers, 367 pp.
Moscow: Academy of Sciences of the U.S.S.R. (1960).

These volumes contain the papers presented at the Conference called by the Cosmic Ray Commission of the International Union of Pure and Applied Physics in Moscow, July 6-11, 1959. Abstracts of the papers will be found in the appropriate chapters of this or succeeding issues of "Physics Abstracts".

537.59

7428 ORIGIN OF COSMIC RADIATION. B.Peters.
Nuovo Cimento Suppl., Vol. 14, No. 2, 436-55 (1959).

A review is given of a recent theory of the origin of cosmic radiation. The theory derives from a theory of the origin of galacti radio noise, which is assumed to arise from the motion of electrons spiraling in the magnetic fields of supernovae. These electrons eventually escape, along with the nuclear particles accelerated by the same fields, and together these give rise to the observed cosmic rays. Although calculations are in a preliminary state it appears th the theory explains the intensity, energy spectrum and composition the primary cosmic radiation, as well as the observed radio emissi E.J.Squires

537.59 : 523.7

ON THE ORIGIN OF TERRESTRIAL PARTICLES FROM SOLA FLARES. See Abstr. 6583

537.59 : 523.1

SOLAR RADIO BURSTS AND LOW-ENERGY COSMIC-RAYS. See Abstr. 6558

537.59

7429 HEAVY NUCLEI IN THE PRIMARY COSMIC RAYS OVER MINNESOTA. E.Tamai.
Phys. Rev., Vol. 117, No. 5, 1345-51 (March 1, 1960).

An analysis of the heavy primary cosmic rays ($Z \geq 2$) was mad by using a stack of emulsions which was exposed at a high altitude on 18 Sept. 1956, over Minnesota. In order to examine the low rigidity portion of the heavy primary cosmic rays, only the stopped particles in this stack were studied. In this work, two methods were employe to identify the charges of various particles: (1) track width measurement and (2) δ-ray density versus residual range. The energy spectra of α, L, and M groups in the primary cosmic radiation were obtained. Their energy spectra show the existence of a maximum in each group, and the energy regions of the maxima increase with increasing charge of heavy element. Some possible interpretations of these spectra are discussed.

537.59

7430 ON THE TRANSITION EFFECT OF EXTENSIVE AIR SHOWERS. A.Somogyi.
Acta phys. Hungar., Vol. 7, No. 2, 189-97 (1957).

From experimental results reported previously (Abstr. 4508 of 1957), it is concluded that the ratio of the number of primary particles in an extensive shower, which are capable of producing at leas one ionizing secondary beneath a given absorber, to the number of all ionizing particles (this ratio is called "transition factor") depen on the shower density. It follows further that the transition factor i a power function of the total number of particles contained in the shower with an exponent between 0 and 0.2 for thicknesses of lead absorber between 0 and 25 mm. This power function permits the determination of the average total number of particles contained in showers recorded by the apparatus and the average distance of the shower axis from the apparatus.

537.5

7431 CASCADE THEORIES AND THE LANDAU APPROXIMATION. J.W.Gardner.
Proc. Phys. Soc., Vol. 75, Pt 2, 205-16 (Feb., 1960).

The track-length angular structure function $f(E\theta/E_s)$ of high energy ($> 5 \times 10^8$ eV) electrons in air showers is calculated without the use of the Landau multiple scattering approximation, which has been used in all previous work except that of Chartres and Messel (1955). Chartres (1956) used the Tamm—Belenky model of the cascade; the present work is based on the simpler "AS" model (approx mation A, super-simplified cross-sections). The results obtained are compared with those of Chartres, and with those of Kalos and Blatt (1954) who used the AS model in conjunction with the Landau approximation. It is concluded that the error introduced by the sim plicity of the model used is small compared with that introduced by the Landau approximation. Except near $E\theta/E_s = 0$, where the As model is not expected to hold, the present treatment gives values of $f(E\theta/E_s)$ in excellent agreement with Chartres' calculations based on the more refined cascade model.

537.5

7432 ANGULAR DISTRIBUTION OF SHOWER PARTICLES IN EXPLOSIVE SHOWERS PRODUCED BY HIGH-ENERGY COSMIC-RAY PARTICLES.
A.P.Mishakova and B.A.Nikolskii.
Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1594-603 (Dec., 1959).
In Russian.

The angular distribution of shower particles in showers with a energy of 10^{10}-10^{13} eV was investigated in the c.m.s. Experimental and calculated results are presented for the dependence of the number of shower-particle pairs on the angle between them. It is concluded that a collision of the primary particle and nucleus leads to a symmetric angular distribution of the shower particles in the c.m.s. and that there is no correlation between the angles of shower-particle pairs.

537.59

7433 VERY-HIGH-ENERGY EXTENSIVE AIR SHOWERS.

A.T.Abrosimov, G.A.Bazilevskaya, V.I.Solov'eva and G.B.Khristiansen.
Zh. eksper. teor. Fiz., Vol. 38, No. 1, 100-7 (Jan., 1960).
In Russian.

Extensive air showers with from 5×10^6 to 10^8 particles were investigated. The paper presents data on the absolute shower intensity, the distribution of showers by the number of particles in them and the spatial distribution of the electron—photon component and of the μ-mesons of these showers. Data on the electron—photon component indicate that either in the lower atmosphere there is no balance between the electron—photon and nuclear components in very-high-energy showers, or else the spatial distribution of electrons is determined not only by Coulomb scattering but also by angular divergence of particles in nuclear-cascade events.

537.59

7434 STATISTICAL DISTRIBUTION OF COSMIC RAY STARS IN NUCLEAR EMULSIONS.

I. Sain Mittra and P.S.Gill.
Proc. Nat. Inst. Sci. India A, Vol. 24, No. 6, 399-418 (1958).

A study of statistical distribution of cosmic ray stars in nuclear emulsions is made in order to find out any interrelationship amongst them. It has been found that the number of close-pairs of stars separated by small mutual distances is much greater than is expected on the basis of random distribution. There is some evidence for the existence of two maxima in the distribution of close-pairs, which have been attributed to two different agencies giving rise to the close-pair effect. The effect of the lead absorber has also been studied. The results have been analysed in the light of the various mechanisms which can give rise to the anomalous distribution of stars.

537.59

7435 ENERGY DEPENDENCE OF TRANSIENT CHANGES IN THE PRIMARY COSMIC-RAY SPECTRUM.

K.G.McCracken.
Phys. Rev., Vol. 117, No. 6, 1570-9 (March 15, 1960).

Quantitative comparisons are made between the cosmic-ray intensity variations observed by a Geiger counter telescope and ionization chamber at a high geomagnetic latitude, high latitude neutron monitors at sea level, and at two different mountain altitudes, Geiger counter telescopes situated 40 metres of water equivalent underground, and a neutron monitor and Geiger counter telescopes at a low geomagnetic latitude. Long-term and short-term variations are considered. As the intensity variations were large, and as the instruments were all of good statistical accuracy, considerable reliance can be placed in the determinations. It is shown that similar comparisons published by other investigators are in agreement with these determinations, provided adequate allowance is made for the altitudes at which the data were obtained. Writing the differential energy spectrum of the primary cosmic radiation as $j(E)$, and measuring E in GeV, the inter-instrument comparisons are used to show that the average spectral changes approximate to the law $\delta j(E) = \text{const}\ (1 + E)^{-\beta} j(E)$; where $\beta \cong 1.2$ for long-term variations. It is shown that the amplitude of the long-term variation is markedly dependent upon altitude. Some evidence is presented that there might be a north—south asymmetry in the long-term variation, the amplitude being greater in southerly directions.

537.59

7436 A STUDY ON THE COSMIC RAY NUCLEAR INTERACTIONS IN LEAD AT 9000 FT.

R.N.Mathur and P.S.Gill.
Indian J. Phys., Vol. 32, No. 19-25 (Jan., 1958).

Nuclear disintegration rates in lead plates of different thicknesses have been studied under no absorber and under 280 g/cm^2 of lead absorbers. The transition phenomena is exhibited by both the unfiltered and filtered N-radiation. A comparative study, however, reveals a change in the characteristics of the N-radiation when filtered through the absorber. Unfiltered N-radiation shows a broad maximum around 25 g/cm^2 of Pb. For filtered N-radiation, however, there appears to be an upward shift in the position of the maximum. The interaction mean free path of the unfiltered N-radiation is obtained equal to 200 g/cm^2 of lead. Filtered N-radiation, however, seems to have an interaction mean free path greater than 250 g/cm^2 of lead. The absorption mean free path of the N-radiation is obtained as 340 g/cm^2 of lead.

537.59

7437 FLUX AT SEA LEVEL OF HEAVY CHARGE PARTICLES PAIR-PRODUCED IN COSMIC RAY SHOWERS.

A.Goldberg.
Phys. Rev., Vol. 117, No. 4, 1128-9 (Feb. 15, 1960).

The flux at sea level of charged particles with mass 300-600 electron masses is calculated assuming the particles to be pair-produced by cosmic ray photons. The cross-section for pair production, including the effects of nuclear size, is folded into the distribution of photons predicted by shower theory. Absorption of the particles produced is also considered approximately. The results are well below the experimental upper limit set up by Keuffel et al. (Abstr. 1666 of 1959).

537.59

7438 ATMOSPHERIC EFFECTS ON THE HARD COMPONENT OF COSMIC RADIATION NEAR SEA LEVEL.

W.R.French, Jr and R.L.Chasson.
J. atmos. terrest. Phys., Vol. 14, No. 1-2, 1-18 (April, 1959).

Atmospheric effects on the hard component of cosmic radiation were studied at Lincoln, Nebraska (51°N geomagnetic latitude; 350 m altitude) with narrow- and wide-angle Geiger-counter telescopes (20 cm Pb absorber). Intensity measurements were made from 1 Sept., 1953 to 16 Feb., 1956, and linear regression analyses were carried out for several possible combinations of atmospheric variables and the cosmic-ray intensity. A detailed comparison is made of the results obtained from triple-regression calculations based upon the 50 mb, 100 mb and 200 mb Duperier models and the Olbert model. It is found that the 50 mb Duperier model is superior to all others tested, but the extent to which the intensity can be corrected by statistical methods is limited at present by the accuracy of the radiosonde data. Experimental results are in good agreement with those of other investigators and agree well with the theoretical predictions of Trefall with regard to the temperature effect. They are in poor agreement with the predictions of Trefall on the barometric effect, however, and do not substantiate the theoretical conclusions of Olbert. The smoothing of the intensity curves seems to be practically indifferent to the terms employed in the regression equation if it involves three or more atmospheric variables.

537.59

7439 ATMOSPHERIC EFFECTS AND PERIODICITIES OF THE COSMIC RADIATION MEASURED 8 m BELOW GROUND.

T. Sándor, A. Somogyi and F.Telbisz.
Acta phys. Hungar., Vol. 11, No. 2, 204-7 (1960).

Reports measurements of absorption and decay coefficients at Budapest during 1957. The mean amplitude of the daily variation was (3.0 ± 0.2)% with a maximum at 13.8 ± 0.3 hours UT for 8 m underground, and (0.8 ± 0.1)% with a maximum at 11.4 ± 0.2 hours for 18 m.
E.J.Burge

537.59 : 551.5

7440 COSMIC-RAY INTENSITIES AND LIQUID-WATER CONTENT IN THE ATMOSPHERE.

H.Arakawa.
J. geophys. Res., Vol. 64, No. 6, 625-9 (June, 1959).

Cosmic-ray intensity data have been studied in Japan, and it has been found that passages of cold fronts do not produce a pronounced variation in cosmic-ray intensitites. Warm fronts produce a gradual but pronounced decrease. Further evidence from the decrease in neutron counts accompanied by little change in ionization chamber records substantiates the conclusion that the variations are due to liquid-water content of the atmosphere. Estimates of as much as 50 to 70 mm of liquid water in the atmosphere are supported by records of tremendous rainfall during the passages of typhoons.

537.59 : 539.12

7441 POLARIZATION OF COSMIC-RAY μ^+-MESONS IN THE HIGH-ENERGY REGION.

N.M.Kocharyan, Z.A.Kirakosyan, E.G.Sharoyan and A.P.Pykalov.
Zh. eksper. teor. Fiz., Vol. 38, No. 1, 18-21 (Jan., 1960). In Russian.

Polarization of cosmic-ray μ^+-mesons with energies close to 2 GeV was measured. The obtained value of $P = 0.23 \pm 0.12$ indicates that, in the upper layers of the atmosphere, μ-mesons originate predominantly from π-meson decay. It was found that the number of μ-mesons produced by $K_{\mu 2}$-decay cannot exceed 15% of the total number of μ-mesons.

537.59 : 523.5

PARTICLE CURRENT DENSITY OF COSMIC RAYS, FROM STONE METEORITE TRITIUM CONCENTRATIONS.
See Abstr. 6581

NUCLEUS

539.14

7442 NUCLEAR ORIENTATION.
L.Rosenfeld.
Physica, Vol. 24, Supplement, S63 (Sept., 1958).

Low Temperature Physics Conference (See Abstr. 7017 of 1960).

539.14 : 539.17

7443 MOMENTUM DISTRIBUTION OF PROTONS IN CARBON.
J.D.Dowell, W.R.Frisken, G.Martelli and B.Musgrave.
Proc. Phys., Soc., Vol. 75, Pt 1, 24-32 (Jan., 1960).

Quasi-elastic interactions of 930 MeV protons with bound protons in carbon have been investigated, using a propane bubble chamber. A method has been devised to relate the measured scattering angles to the momenta of the bound nucleons. A Gaussian curve falling to 1/e at a momentum corresponding to a kinetic energy of 13 MeV has been fitted to the experimentally determined momentum distribution. The cross-section for quasi-elastic reactions in carbon is found to be 46 ± 10 millibarns, considerably higher than values which might be inferred from results of previous experiments.

539.14 : 539.17

NUCLEON MOMENTA IN NUCLEI. See Abstr. 5742

539.14

7444 SINGLE PARTICLE MOTION IN A DEFORMED, NONLOCAL POTENTIAL WELL. R.H.Lemmer.
Phys. Rev., Vol. 117, No. 6, 1551-61 (March 15, 1960).

The effects of the nonlocal character of the average nucleon—nucleus interaction on single particle motion in a strongly deformed field are examined by using a simple phenomenological description of the nonlocal interaction and introducing an effective mass approximation for a finite nuclear system. The eigenvalues and eigenfunctions of the anisotropic harmonic oscillator potential are used as a starting point for a perturbative treatment of the nonlocal interaction, and the resulting energy level scheme is given as a function of the nuclear deformation. A conventional spin-orbit interaction is also included in these calculations. The main effects of the nonlocal interaction appear as an increase in the level spacing of the unperturbed oscillator states combined with an additional interaction energy which can be interpreted as an effective angular momentum dependence of the average potential field. Calculations of nuclear equilibrium deformations based on the computed level schemes are presented. It is found that the preponderance of prolate nuclear shapes found empirically can be accounted for quite well by the nonlocal model and results essentially from the favouring of high angular momentum substates that are introduced by the nonlocal interaction.

539.14

7445 TRANSFORMATION BRACKETS FOR HARMONIC OSCILLATOR FUNCTIONS. T.A.Bródy.
Rev. Mexicana Fis., Vol. 8, No. 3, 139-227 (Oct., 1959). In Spanish.

In an earlier paper (Abstr. 5517/1960) Moshinsky introduced transformation brackets that enabled two-nucleon matrix elements to be expressed directly in terms of Talmi integrals. Numerical values are given for these transformation brackets in the case of $n_1 = n_2 = 0$ and $l_1 \leq l_2 \leq 6$, $l \leq 6$, $L \leq 12$; where n_1, n_2; l_1, l_2 are the radial and angular momentum quantum numbers of the two particles moving in a common potential and l, L are the angular momentum quantum numbers in the relative and centre-of-mass coordinates.

A.M.Green

539.14

7446 NUCLEAR MODELS.
R.van Wageningen.
Amer. J. Phys., Vol. 28, No. 5, 425-36 (May, 1960).

A summary is given of the development of nuclear models, both for the description of structure and of scattering and reaction processes. The treatment is qualitative, and follows mainly the historical development. Models discussed are the liquid drop model, the potential well model for nuclear reaction processes, the compound nucleus model for nuclear reactions, and the shell model. Then a summary and comparison is made, followed by a brief sketch of the unified or collective model, which is a unificatio of the liquid drop and the shell model. Finally the nuclear optical model or complex potential well model is discussed.

539.14 : 539.

7447 THE OPTICAL MODEL OF LIGHT NUCLEI.
P.B.Jones.
Proc. Roy. Soc. A, Vol. 255, 253-66 (April 5, 1960).

A derivation of the optical operator is presented for a nucleus of any mass number $A \geq 1$. The special case of $A = 1$ is considere The formalism is extended to include compound incident particles, and particles, such as K^- mesons, for which true absorption proce are important. An approximate evaluation is made for K^+-He^4 elastic scattering at a number of energies. Both real and imaginar parts of the potential are non-local. The radial dependence of each non-locality is calculated. The accuracy of the impulse approxima for K^+-He^4 scattering is investigated. Correlations in the He^4 ground-state wave-function are shown to be important in the interpretation of both the empirical local optical model potential and the charge distribution determined by high-energy electron scattering.

539.1

7448 NEUTRON STRENGTH FUNCTIONS IN A SURFACE ABSORPTION OPTICAL MODEL.
F.C.Khanna and Y.C.Tang.
Nuclear Phys., Vol. 15, No. 2, 337-41 (Feb. (2), 1960).

The effect of a surface-peaked imaginary optical potential on t S-wave neutron strength functions was investigated. Analyses were carried out with both a local potential and a non-local potential of the form used recently by Green and Wyatt in an effort to unify the scattering and bound-state problems. The results indicate that wit a surface-peaked imaginary potential, the deep valley between the giant resonances (90 < A < 130) may be fairly well accounted for.

539.1

7449 ON THE ELIMINATION OF THE BARYCENTRIC AND ROTATIONAL COORDINATES IN A NUCLEAR "SHELL-MODEL" [AND SOME OF ITS CONSEQUENCES].
B.R.Holmberg.
K. Tekn. Högsk. Handl., No. 145, 27 pp. (1959).

539.1

7450 SYMPLECTIC SYMMETRY IN THE NUCLEAR SHELL MODEL. J.B.French.
Nuclear Physics, Vol. 15, No. 3, 393-410 (March (1), 1960).

The nature of the general two-particle interactions which is compatible with symplectic symmetry in the jj coupling shell model is investigated. The essential result is that, to within an additive constant and an additive multiple of T^2, the interaction should have the form of a sum of scalar products of single-particle tensors which have odd rank in the single-particle j space. An example of an interaction satisfying these conditions is a central interaction with $\sigma_1 . \sigma_2$ exchange nature. The condition for good symplectic symmetry is expressed also as a set of linear constraints on the two-particle energies, again as constraints on the particle—hole energies and finally in terms of the relationship between the particle—particle and particle—hole spectra. When one deals with identical particles only, the conditions for good symplectic symmet (or seniority) are greatly relaxed and in particular are satisfied fo a short-range (δ-function) interaction, as shown earlier by Racah a Talmi.

539.1

7451 GROUP-THEORETICAL INVESTIGATIONS IN CONNECTION WITH THE SHELL MODEL. II. TRANSLATION—INVARIANCE PROBLEM. M.Kretzschmar.
Z. Phys., Vol. 158, No. 3, 284-303 (1960). In German.

For Pt I, see Abstr. 5647 (1960). The scheme of Pt I is applied to a translation-invariant Hamiltonian with harmonic oscillator forces. The existence of a shell structure for the ground states is proved and the quantum numbers and symmetry propertie of the wave-functions of the ground states and of some excited states are derived. If translation-invariance is neglected, spuriou states appear. It is shown how their quantum numbers and symme properties can be determined. Some remarks are made on a trans lation-invariant formulation of the Elliot model.

539.14

7452 CLUSTERING OF NUCLEONS IN LIGHT NUCLEI.

V.G.Neudachin, Yu.F.Smirnov and N.P.Yudin.
Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1781-3 (Dec., 1959). In Russian.

Equivalence of wave-functions of the shell theory with LS-coupling for states with higher symmetry of the orbital part and antisymmetrized wave-functions composed of wave-functions of nucleon clusters is demonstrated using the permutation group theory. Some simple examples are considered.

539.14

7453 QUASI-PARTICLES AND COLLECTIVE STATES OF SPHERICAL NUCLEI.

R.Arvieu and M.Vénéroni.
C.R. Acad. Sci. (Paris), Vol. 250, No. 6, 992-4 (Feb. 8, 1960). In French.

This note writes down the Hamiltonian obtained by applying the method of Bogolyubov in the theory of superconductivity to the shell model of spherical nuclei. J.Goldstone

539.14

7454 ON THE COLLECTIVE MODEL WAVE FUNCTIONS.

Z.Jankovic.
Nuovo Cimento, Vol. 14, No. 5, 1174-6 (Dec. 1, 1959).

A. Bohr's collective Hamiltonian is separated into two parts, one a function of the parameter β, which is solved explicitly; and the other a function of the parameters γ and the θ_i's, which is solved by using an expression suggested by the known symmetry properties of the collective wavefunction. Also a method is indicated for the solution of a more generalized Hamiltonian, the results of which are to be in a later paper. A.M.Green

539.14 : 539.19

7455 ON THE INTERACTIONS OF NUCLEAR SPIN WITH ELECTRONS IN NEIGHBORING MOLECULES.

C.C.Lin.
Ann. Phys. (New York), Vol. 9, No. 2, 325-31 (Feb, 1960).

The interactions of the nuclear spin with the orbital and spin angular momenta of electrons in neighbouring molecules were examined and expressions for the coupling energy were derived. The gradual transition from scalar (I·L) to dipolar (I·L) - $3R^{-2}$ (I·R)(L·R) type coupling is traced as the centre of the electron charge distribution is moved away from the nucleus. The usual formula for the Fermi contact interaction is shown to be valid even if the nucleus is not at the centre of the electronic charge distribution, provided $|\psi|^2$ be evaluated at the nucleus. Applications of the results to the nuclear resonance experiments are discussed. One effect is a shift of the nuclear resonance lines in case the nucleus is overlapped by the charge distribution of the neighbouring paramagnetic atoms.

539.14

7456 SPIN OF THE FIRST EXCITED STATE OF B^{12}.

E.Kondaiah and C.Bradrinathan.
Nuclear Phys., Vol. 15, No. 2, 254-60 (Feb. (2), 1960).

Angular distribution of gamma-rays arising from the 0.95 MeV level of B^{12} in the reaction $B^{11}(d,p)B^{12}$ was studied at a deuteron energy of 0.8 MeV. It was found that the gamma angular distribution is definitely non-isotropic and has a minimum at an angle of 45° to the incident deuteron beam. This leads to the exclusion of 0 ±, 1^- and 2^- assignments to the 0.95 MeV level in B^{12} leaving the possible assignments 2^+ or 3^+.

539.14

7457 NUCLEAR MAGNETIC DIPOLE AND ELECTRIC QUADRUPOLE MOMENTS OF RADIOACTIVE BISMUTH ISOTOPES.

I.Lindgren and C.M.Johansson.
Ark. Fys., Vol. 15, Paper 33, 445-62 (1959).

The hyperfine structure of the neutron-deficient bismuth isotopes $Bi^{203-206}$ has been studied by the atomic beam magnetic resonance method by use of six-pole focusing and radioactive detection. The results are summarized in the following table:

Isotope	Half-life	Spin	a Mc/s	b Mc/s	μ_I n.m.	Q 10^{-24} cm^2
Bi^{203}	12 hr	9/2	−502.4±3.0	−558±25	+4.59±0.05	−0.64±0.05
Bi^{204}	13 hr	6	−349.0±2.0	−358±20	+4.25±0.05	−0.41±0.05
Bi^{205}	14.5 d	9/2	(−600)		(+5.5)	
Bi^{206}	6.3 d	6	−374.7±3.0	−166±30	+4.56±0.05	−0.19±0.05

The magnetic dipole moments (μ_I) are calculated from the magnetic dipole interaction constants (a) by means of the known values of a and μ_I of Bi^{209} and the Fermi—Segré formula, neglecting the h.f.s. anomaly. In order to obtain the electrical quadrupole moments (Q) from the electric quadrupole interaction constants (b), the intermediate state of bismuth has been determined from the optically measured energy levels and from the known g_J-value of the ground state. The average of the inverse cube of the distance of the electrons from the nucleus, $\langle r^{-3}\rangle$, has been calculated from the magnetic dipole interaction in Bi^{209} and is compared with the value obtained from the spin-orbit coupling. The quadrupole moments are not corrected for the effect of distortion of the inner electron shells (Sternheimer's correction). The results are compared with theoretical values obtained from the nuclear shell model.

539.14

7458 MAGNETIC MOMENT OF Fe^{57}.

G.W.Ludwig and H.H.Woodbury.
Phys. Rev., Vol. 117, No. 5, 1286-7 (March 1, 1960).

An electron-nuclear double resonance study was made on the spectrum of neutral iron atoms in silicon. These measurements lead to a value of +0.0903 ± 0.0007 n.m. for the magnetic moment of Fe^{57}.

539.14

7459 MAGNETIC MOMENT OF Au^{197}.

H.H.Woodbury and G.W.Ludwig.
Phys. Rev., Vol. 117, No. 5, 1287-8 (March 1, 1960).

Chromium—gold and manganese—gold impurity pairs in silicon were observed by electron spin resonance techniques. Electron-nuclear double resonance studies of the gold hyperfine structure lead to a value of 0.1439 ± 0.0004 n.m. for the magnetic moment of Au^{197}.

539.14 : 539.18

THE QUADRUPOLE MOMENT OF Na^{23}. See Abstr. 7701

539.14

7460 COLLECTIVE PROPERTIES OF Si^{30}, Si^{31} AND Ne^{23}, AND REDUCED WIDTHS IN STRIPPING REACTIONS.

V.G.Sukharevskii.
Zh. eksper. teor. Fiz., Vol. 38, No. 1, 219-21 (Jan., 1960). In Russian.

In the framework of the strong coupling unified model investigation has been made of Si^{30}, Si^{31} and Ne^{23} collective properties by analysing experimentally obtained reduced neutron widths in (d,p) stripping reactions. The analysis indicates that Si^{31} is apparently oblate with the Nilsson deformation parameter $\delta < 0$. The analysis does not make it possible to ascertain the shape of Ne^{23} deformation although it does confirm that this nucleus is strongly distorted. The result obtained for Si^{30} does not agree with theoretical calculations and this fact makes it doubtful whether a strong coupling scheme can be applied to this nucleus.

539.14 : 539.2

7461 SOME SIMPLE FEATURES OF THE MÖSSBAUER EFFECT.

H.J.Lipkin.
Ann. Phys. (New York), Vol. 9, No. 2, 332-9 (Feb., 1960).

A simple description is given of the change in the state of a crystal lattice upon emission or absorption of a nuclear gamma-ray by a bound nucleus. A sum rule is derived for the average energy transfer to the lattice. The probability of zero energy transfer is calculated. The results are general and do not assume a particular model for the crystal. Conclusions are presented as simple principles which may be useful as a guide to experimentalists.

539.14

7462 ON THE RESONANT EXCITATION OF METASTABLE NUCLEAR LEVELS OF VERY LONG LIFETIME.

C.Tzara.
C. R. Acad. Sci. (Paris), Vol. 250, No. 8, 1466-7 (Feb. 22, 1960). In French.

Discusses the possibility of resonant excitation by the Mössbauer effect of states with lifetimes of the order of one minute. In silver the width due to magnetic interaction with the crystal is estimated at 10^{-13}eV. J.Goldstone

539.14

7463 POLARISED SPECTRA AND HYPERFINE STRUCTURE IN FE^{57}.

S.S.Hanna, J.Heberle, C.Littlejohn, G.J.Perlow, R.S.Preston and D.H.Vincent.
Phys. Rev. Letters, Vol. 4, No. 4, 177-80 (Feb. 15, 1960).

Describes an experiment which was used to measure the polarization in the hyperfine spectrum of the resonant absorption associated with the 14 keV level of Fe^{57}. The results clearly show that earlier interpretations of the hyperfine spectra, based on the existence of four lines, are incorrect, and an explanation of the data which involves six lines is given. E.J.Squires

539.14

7464 TIME SPECTRA OF FILTERED RESONANCE RADIATION OF Fe^{57}.

R.E.Holland, F.J.Lynch, G.J.Perlow and S.S.Hanna.

The 14 keV -radiation from Fe^{57} is partially absorbed by a foil of Fe^{57} and the time variation of the transmitted intensity measured. Since the transmitted radiation has a different spectral distribution from the initial radiation this time decay is not exponential. The results are in qualitative agreement with theoretical prediction. E.J.Squires

539.14

7465 NUCLEAR RESONANCE ABSORPTION AND NUCLEAR ZEEMAN EFFECT IN Fe^{57}.

G.DePasquali, H.Frauenfelder, S.Margulies and R.N.Peacock.
Phys. Rev. Letters, Vol. 4, No. 2, 71-3 (Jan. 15, 1960).

A Mossbauer type resonance absorption in Fe^{57} in ferromagnetic natural iron at 200°C is described. As the Zeeman splitting of the nuclear levels due to hyperfine coupling of the nucleus with the electrons is larger than the line width it can be observed directly. The source consists of carrier-free Co^{57} in less than 1 mg of iron, and the absorber is an iron foil which can be rotated over a continuous range of constant speeds. This provides the Doppler shift necessary to sweep over the absorption curve. The nuclear spin in the excited state is 3/2 and the magnetic moment is found to be 0.50 n.m. if the field at the nucleus is taken to be 10^5G. J.M.Baker

539.14

7466 POLARIZATION OF NUCLEAR RESONANCE RADIATION IN FERROMAGNETIC Fe^{57}.

G.J.Perlow, S.S.Hanna, M.Hamermesh, C.Littlejohn, D.H.Vincent, R.S.Preston and J.Heberle.
Phys. Rev. Letters, Vol. 4, No. 2, 74-5 (Jan. 15, 1960).

Recent observations have shown that the 14 keV radiation from Fe^{57} undergoes a strong absorption of the Mossbauer type at room temperature and that the absorption spectrum displays a hyperfine structure. The experiment described consists of determining the variation of resonant absorption as a function of angle between the magnetizations of the source and absorber. Relative to the internal field at the iron nuclei the radiation emitted in the transition from one magnetic sublevel to another is linearly polarized when viewed perpendicular to the field. Hence the magnetization of the source serves as a polarizer of radiation, and in like manner that of the absorber serves as an analyser of the polarization. This experiment provides a direct demonstration of the strong correlation in direction between the magnetization and the internal field at the nucleus in a ferromagnet, and also it can provide information on the hyperfine structure of the levels in Fe^{57}. J.M.Baker

539.14

7467 EXPERIMENTS TO TEST EINSTEIN'S PRINCIPLE OF EQUIVALENCE. T.E.Cranshaw and J.P.Schiffer.

Nature (London), Vol. 185, 653-4 (March 5, 1960).

Describes experiments utilizing the Mössbauer effect carried out independently at Harvard and at Harwell on measurement of the frequency shift due to the difference of the gravitational potential between an Fe^{57} emitter and an absorber placed at different heights. In another type of experiment, at Harwell, a rotating system was used giving accelerations of up to 65 000 g. The preliminary results are of the right magnitude. W.A.Hepner

539.14 : 530.12

7468 MEASUREMENT OF THE GRAVITATIONAL RED SHIFT USING THE MÖSSBAUER EFFECT IN Fe^{57}.

T.E.Cranshaw, J.P.Schiffer and A.B.Whitehead.
Phys. Rev. Letters, Vol. 4, No. 4, 163-4 (Feb. 15, 1960).

The experimental arrangement is described. The difference in height was 12.5 metres, which gives an expected fractional red shift of 1.36×10^{-15}. The observed shift was equal to the expected shift multiplied by 0.96 ± 0.45 E.J.Squires

539.14 : 530.12

7469 MEASUREMENT OF THE RED SHIFT IN AN ACCELERATED SYSTEM USING THE MÖSSBAUER EFFECT IN Fe^{57}.

H.J.Hay, J.P.Schiffer, T.E.Cranshaw and P.A.Egelstaff.
Phys. Rev. Letters, Vol. 4, No. 4, 165-6 (Feb. 15, 1960).

The Co^{57} source used in this experiment was plated on to a 0.8 cm diameter iron cylinder which was rotated at speeds up to 500 c/s. The expected fractional shift in the energy was $2.44 \times 10^{-20}\,\omega^2$, which could be observed at angular velocities down to about 50 c/s. The agreement with the expected shift is good throughout the range of velocities. E.J.Squire

539.14 : 530.1

7470 UPPER LIMIT FOR THE ANISOTROPY OF INERTIA FROM THE MÖSSBAUER EFFECT.

G.Cocconi and E.E.Salpeter.
Phys. Rev. Letters, Vol. 4, No. 4, 176-7 (Feb. 15, 1960).

It is shown how the use of the Mössbauer effect enables an upper limit to be placed on the variation of inertial mass with direction of acceleration. Present results indicate that $\Delta M/M < \sim 10$ but it should be possible to improve this limit considerably. E.J.Squire

539.1

7471 ON THE APPEARANCE OF DEFINITE EXCITATION ENGERGIES IN DIFFERENT NUCLEI. F.Everling.

Z. Naturforsch., Vol. 15a, No. 1, 84-5 (Jan., 1960). In German.

By studying the energy level schemes of light nuclei, it can be seen that the 0^+ excitation engeries of self-conjugate even—even nuclei reappear frequently in the energy spectra of other nuclei, as energy differences between levels of the same spin and parity. The explanation of this in terms of the shell model is briefly considered. E.J.Squire

539.1

7472 MEASUREMENT OF g-FACTORS OF SEVERAL SHOR LIVED NUCLEAR STATES IN ODD-MASS NUCLEI.

G.Manning and J.D.Rogers.
Nuclear Phys., Vol. 15, No. 1, 166-86 (Feb. [1], 1960).

The g-factors of several excited states were measured by observing the rotation of the angular correlation of $\gamma - \gamma$ cascades by an applied magnetic field. The results are: 280 keV state of As^{75}($\tau = 3.4 \times 10^{-10}$ sec), g = 0.42 × 0.13; 114 keV state of Lu^{175} ($\tau = 9.4 \times 10^{-11}$ sec), g = 0.5 ± 0.2; and 113 keV state of Hf^{177} ($\tau = 6 \times 10^{-10}$ sec), g = 0.22 ± 0.06. These results are found to be in good agreement with the theoretical predictions of the Nilsson model. For the case of As^{75} other relevant properties are also compared with the model predictions. The results indicate that the model can be usefully applied to As^{75} and that the nucleus has a prolate deformation ($\eta \cong 2.5$). The g-factor of the 91 keV level of Pm^{147} was also studied, a definite rotation of the angular correlatio being observed. Computation of the g-factor from the observed data is uncertain because the time dependent attenuation of the $\gamma - \gamma$ correlation is not known. The results are $g = (0.9 \pm 0.2)/G_2$. The effect of the paramagnetic nature of the rare-earth ions on such measurements on this group of nuclei is discussed in an appendix. Other assumptions made in deducing the g-factors from the observe rotations of the angular correlations are also discussed.

539.1

7473 EXCITED LEVELS OF Dy^{161}. M.Vergnes.

J. Phys. Radium, Vol. 18, No. 10, 579-84 (Oct., 1957). In French.

The excited levels of Dy^{161} following the β disintegration of Tb^{161} have been studied. Three photons of 25.5, 49 and 74.5 keV were found, the latter being the cross over of the cascade formed by the first two: 49 kEv, 25.5 keV. Two excited levels at 25.5 keV and 74.5 keV are so defined. The periods of these two levels have been measured:

$$T\ 1/2\ (25.5) = 2.7 \pm 0.2 \times 10^{-8}\ \text{sec},$$

and

$$T\ 1/2\ (74.5) = 2.3 \pm 0.7 \times 10^{-9}\ \text{sec}.$$

The two photons of 25.5 and 74.5 have been found to be E1 (+M2). The gamma transition of 25.5 keV is forbidden by a factor of about 10^4 compared to the single-proton estimate of Weisskopf. A level scheme is given.

539.14 : 539.1

7474 EXCITED STATES IN N^{14} FROM $C^{12}(d,d)C^{12}$, $C^{12}(d,p_0)C^1$ AND $C^{12}(d,p_1)C^{13*}$. E.Kashy, R.R.Perry and J.R.Risse

Phys. Rev., Vol. 117, No. 5, 1289-96 (March 1, 1960).

Excited states in the N^{14} nucleus were observed by measuring the differential scattering and reaction cross-sections of $C^{12}(d,d)C^1$

C^{12}(d,p$_0$)C^{13}, and C^{12}(d,p$_1$)C^{13*} for deuteron bombarding energies from 0.5 to 2.0 MeV. Resonances were investigated at deuteron bombarding energies of 0.92, 1.19, 1.31, 1.446, and 1.79 MeV, corresponding to excited states at 11.05, 11.29, 11.39, 11.503, and 11.80 MeV in N^{14}. Scattering matrix analysis of the elastically scattered deuterons and of angular distributions of the reaction protons to the ground state of C^{13} gave assignments of 1$^+$, 2$^-$, 1$^+$, 3$^+$, and 1$^+$ for these states. The analysis of the C^{12}(d,p$_0$)C^{13} angular distributions at 0.92, 1.19, and 1.31 MeV indicated a reaction mechanism in which the relative proton—neutron spin orientation of the deuteron is preserved.

539.14

7475 THE ENERGY LEVELS OF ^{21}Ne.

S.Hinds and R.Middleton.

Proc. Phys. Soc., Vol. 74, Pt 6, 779-82 (Dec., 1959).

The energy levels of Ne^{21} have been studied up to an excitation of 9.339 MeV. Protons from the reaction F^{19}(He^3, p) Ne^{21} were observed with a broad range magnetic spectrograph. The positions of 67 levels are reported.

L.L.Green

539.14

7476 INTERPRETATION OF THE LOW-EXCITED STATES OF Po^{214} (RaC').

C.Mayer-Böricke and G.Lührs.

Z. Naturforsch., Vol. 15a, No. 2, 103-7 (Feb., 1960). In German.

The K/L amd K/M conversion ratios of the 769 and 609 keV γ-radiations were measured with a double focusing β-spectrometer. For the K/L ratios, the values 3.95 ± 0.2 and 3.43 ± 0.1 were obtained. According to the tables of Rose (1958),both transitions are very pure E2 radiations. This coincides with the conclusions of the theory of collective quadrupole vibrations. This theory — in the modified form of Wilets and Jean (Abstr. 4580 of 1956) — was used for the interpretation of the low-excited levels (609, 1378 and 1416 keV) of Po^{214}. Following this model of γ-unstable quadrupole vibrations, one obtains for the nuclear equilibrium deformation $\beta_0 \cong 6.7 \times 10^{-2}$.

539.14

7477 0+ LEVELS OF EVEN NUCLEI IN THE RARE-EARTH REGION.

I.Marklund, B. Van Nooijen and Z.Grabowski.

Nuclear Phys., Vol. 15, No. 4, 533-65 (March (2), 1960).

The quadrupole vibrations of beta-type of deformed nuclei were found in only a few cases in the heavy-element region. A search was started in order to find such levels also in the rare-earth region. A 0+ level of beta-vibrational type at 685.0 keV was found in the deformed nucleus Sm^{152} by measuring conversion coefficients. Its corresponding 0+ level of two-phonon type was observed in Gd^{152} at 615.3 keV. The strongly deformed nucleus Er^{166} has a 0+ level at 1460.4 keV now confirmed by angular correlation measurements. The 1087 keV level in Os^{188} and the 1267 keV level in the spherical nucleus Pt^{194} were also measured by angular correlation to have zero spins, indicating the same trend of the 0+ levels as theoretically expected. (A second excited 0+ level was found in Os^{188} at 1766 keV and in Pt^{194} at 1480 keV). When the beta- and gamma-vibrational bands are known, the theoretical and experimental rotational—vibrational coefficients can be compared: $B^{\text{theory}} = kB^{\text{exp}}$. A k-value of 2-4 is found, indicating a weaker coupling than that theoretically expected. The experimental trend of levels in even nuclei with A = 50-250 is discussed, and some new spin assignments are proposed.

539.14

7478 A MEASUREMENT OF THE LIFETIME OF THE FIRST EXCITED STATE IN Tl^{200}.

E.Bashandy and J.Lindskog.

Ark. Fys., Vol. 16, Paper 21, 227-9 (1959).

The lifetime of the 148 keV level in Tl^{200} has been remeasured with greater precision than previously and halflife of 7.3 ± 0.3 mμsec found.

L.L.Green

539.14 : 539.1.07

THE LIFETIMES OF EXCITED STATES OF NUCLEI; STATISTICAL ERRORS IN MEASUREMENT. See Abstr. 7258

539.14 : 539.17

NEUTRON EVAPORATION AND LEVEL DENSITIES IN EXCITED NUCLEI. See Abstr. 5736

539.14

7479 NUCLEAR ENERGY LEVELS OF Tu^{169}.

S.A.Baranov, R.M.Polevoi, U.F.Rodionov and G.V.Shishkin.

J. nuclear Energy, Vol. 8, No. 1-3, 166-7 (Nov., 1958). English translation of article in: Atomnaya Energiya, Vol. 3, No. 9, 256 (1957).

Ytterbium of natural isotopic composition was irradiated with slow neutrons for a month. After thirty days the ytterbium was separated chromatographically from other rare earth elements and the Yb^{169} radiation (half life 30.6 days) was examined, using a double focusing β-spectrometer, a scintillation counter and a proportional counter filled with heavy gases (A, Kr). Special attention was paid to the soft part of the β-spectrum and to the soft γ-rays from the Tu^{169}. Using the β-spectrometer, the following conversion lines were first determined: K – 63.13 keV; M$_1$ – N – 8.42 keV; L$_1$M — 20.74 keV. With the proportional counter lines corresponding to the following atomic transitions were observed, L_{α_1}; L_{β_1}; $K_{\alpha_{2,1}}$; $K_{\beta_{3,1}}$ (transition energies 7.18; 8.10; 50.4 and 57.5 keV respectively) and also the γ-transitions of Tu^{169} with energies 21.74 and 63.13 keV. Altogether 13 γ-transitions were detected by the three methods; the multipolarities are shown in brackets. 8.42(M1 + E2); 20.74(M1); 63.13(E1): 93.62(0.9 M1 + 0.1 E2); 109.67(M1); 118.20(E2); 130.48(E2); 156?; 177.21(0.75 M1 + 0.25 E2); 197.97(M1); 240.6(E1?); 307.7(E2) keV. Examination of the γ-rays enabled the following nuclear levels of Tu^{169} to be established: 8.42; 118.20; 138.90; 316.06; 379.19 and 472.8 keV. The ground state of Tu^{169} has spin $I_0 = \frac{1}{2}$. With the multipolarities shown for the γ-transitions, the first three levels can be attributed to rotational levels with spins 3/2±, 5/2± and 7/2±. The last three levels have spins 7/2±, 7/2∓ and 9/2 ∓.

539.14 : 539.17

7480 ON THE CORRELATION OF THE NUCLEAR ENERGY LEVELS OF URANIUM-236 AND PLUTONIUM-240.

P.A.Egelstaff.

J. nuclear Energy, Vol. 7, No. 1-2, 35-44 (Aug., 1958).

The current theoretical treatment of the energy levels excited in slow-neutron bombardment assumes that the level of excitation of the compound nucleus is so high that the parameters of the levels appear to be chosen at random. This assumption has been found to be supported by studies of parameters of individual resonances, but such studies can be made only over an energy region containing perhaps ten levels. A technique is developed by means of which this type of work may be extended over a region containing thousands of levels. This technique is then applied to the slow-neutron fission cross-section of U^{235} and Pu^{239}, and the total cross-section of U^{235}. It is found that there is strong evidence for a correlation existing over an energy range containing approximately sixty levels. A quantitative account of this correlation is worked out on the assumption that the cross-section at any given point is partly determined by the local average cross-section over an interval containing sixty levels.

539.14

7481 REMARKS ON NUCLEI OF REFLECTIONAL ASYMMETRY.

V.M.Strutinski.

J.nuclear Energy, Vol. 4, No. 4, 523-9 (April, 1957). English translation of article in : Atomnaya Energiya, Vol. 1, No. 4, 150 (1956).

A mechanism is proposed for the low-lying levels of spin 1 and odd parity attributed by Bohr to "pear-shaped" states, using a treatment analogous to term crossing in molecular theory. An estimate is made of the dipole moment of an asymmetric nucleus.

E.J.Burge

539.14

7482 ON THE THEORY OF WIGNER SUPERMULTIPLET.

M.Kretzschmar.

Z. Phys., Vol. 157, No. 5, 558-67 (1960). In German.

Group theoretical methods are used to calculate the symmetries with respect to interchange of the nucleons which are possible for a nucleus with particular spin and isotopic spin. In the absence of spin- and charge-dependent forces, the spatial symmetry determines the supermultiplet to which an energy level belongs. A general formula is derived which allows one to calculate directly all the combinations of spin and isotopic spin which occur in a particular supermultiplet.

D.J.Thouless

539.14 : 539.17

7483 NUCLEAR MULTIPLETS IN LIGHT ODD-ODD NUCLEI AND THEIR MANIFESTATION IN GAMMA-TRANSITIONS FOLLOWING THERMAL NEUTRON CAPTURE.

L.V.Groshev and A.M.Demidov.

J. nuclear Energy, Vol. 8, No. 1-3, 103-14 (Nov., 1958). English translation of article in Atomnaya Energiya, Vol. 3, No. 8, 91 (1957).

The states of odd-odd nuclei with A < 60 which differ in total angular momentum, J, but which have given odd proton and odd neutron momenta, j_p and j_n are considered. The experimental evidence for such nuclear multiplets near the ground state is reviewed. The γ-decay schemes of even-odd (odd neutron) and odd-odd nuclei with $A < 60$ formed by thermal neutron capture are compared, and the multiplet hypothesis is used to explain some aspects of the γ-transitions in odd-odd nuclei.

539.14

7484 HYPERNUCLEUS STUDIES. I. MESONICALLY DECAYING HYPERNUCLEI.

S.Lokanathan, D.K.Robinson and S.J.St Lorant.
Proc. Roy. Soc. A, Vol. 254, 470-86 (March 8, 1960).

A systematic study of 260 000 stars produced by 4.3 GeV/c negative π-mesons and of 1000 K^- interaction stars, both in Ilford G5 nuclear emulsion, yielded 46 hypernuclei decaying by the mesonic mode. The identification of these events is described and the binding energy of the Λ^0 hyperon in the nucleus is calculated in each case with the help of a programme written for a Ferranti Mercury computer. The binding energies of the uniquely identified hypernuclei are found to be as follows;

4 cases of ${}_{\Lambda}H^3$; $B_{\Lambda} = 0.67 \pm 0.38$ MeV,
9 cases of ${}_{\Lambda}H^4$; $B_{\Lambda} = 1.94 \pm 0.28$ MeV,
14 cases of ${}_{\Lambda}He^5$; $B_{\Lambda} = 3.21 \pm 0.14$ MeV,
1 case of ${}_{\Lambda}Li^9$; $B_{\Lambda} = 3.51 \pm 3.49$ MeV.

All other events admit alternative interpretations, and the binding energies are tabulated for the various possibilities. Other experimental results are also discussed. The quoted errors in the binding energies are random errors; contributions from systematic sources are discussed and they amount to about 0.3 MeV.

539.14

7485 LOW-ENERGY PARAMETERS OF HYPERON—NUCLEON INTERACTION AND Λ HYPERFRAGMENTS.

S.Iwao and E.C.G.Sudarshan.
Phys. Rev. Letters, Vol. 4, No. 3, 140-1 (Feb. 1, 1960).

A systematic study is made of Λ hyperfragments with a view to finding the matrix elements of the Λ nucleon interaction. For hyperfragments with $A \leq 5$, only the triplet and singlet S state interactions enter, and it is shown that both these are positive. Using the numerical values it is possible to see that ${}_{\Lambda}He^3$ and the hyperdeuteron and the excited states of ${}_{\Lambda}H^4$ and ${}_{\Lambda}He^4$ are unbound. From the latter result one can deduce that the K^- parity relative to the Λ is negative. For the p shell hypernuclei one requires four additional parameters, corresponding to the interaction of $s_{1/2}$ hyperons with $p_{1/2}$ and $p_{3/2}$ nucleons. Suitable choice of these parameters enables fits to be made to the available data. E.J.Squires

RADIOACTIVITY . NUCLEAR DECAY

539.16

7486 METHOD FOR PHOTOGRAPHIC IDENTIFICATION OF MICROSCOPIC RADIOACTIVE PARTICLES.

J.Sisefsky.
Brit. J. appl. Phys., Vol. 10, No. 12, 526-9 (Dec., 1959).

A method is described for identification and microscopy of small radioactive particles mixed with a large amount of inactive ones. The particles are prepared on a celluloid coating on a glass plate. The plate is coated with nuclear emulsion in gel form which is reversal developed in situ leaving the active particles visible, in the centres of clear circular spots against a brown transparent background.

539.16

7487 ELECTRON MICROSCOPY OF AUTORADIOGRAPHED RADIOACTIVE PARTICLES.

L.A.George,II and G.S.Vogt.
Nature (London), Vol. 184, 1474-5 (Nov. 7, 1959).

Describes a technique for the identification of radioactive material collected on millipore filters used in experiments on the inhalation of radioactive particles by animals. Particles are transferred to a specimen grid and photographed in the electron microscope. On removal from the instrument the grids are coated with α-sensitive photographic emulsion and exposed to plutonium 239. After develo
ing and fixing,the particles are re-examined in the electron micro
scope and the radioactive particles are clearly distinguished from
the others. T.Mulv

539.

7488 THE FIELD OF RADIATION OF A RECTANGULAR SOURCE. E.E.Kovalev, V.I.Popov and L.N.Smirennyi

J. nuclear Energy, Vol. 5, No. 3-4, 424-5 (1957). English translation of article in Atomnaya Energiya, Vol. 2, 181 (1957).

The field of radiation for a rectangular source of arbitrary dimensions is calculated, making the following assumptions: (1) the active material is uniformly distributed over the whole surface of the source; (2) there is no self absorption or back scatterin
in the source. On the basis of these assumptions it can be shown that the intensity of radiation at a point distant h, due to a rectang
lar source of sides a and b and surface density of activity σ, is dependent only on the relative dimensions of the source, $n = b/a$; a
its relative distance from the given point, $m = h/a$. Values of n ca
be limited to the range $0 \leq n \leq 1$ without decreasing the generality
of the calculations since it is always possible to make a the large
of the sides of the rectangle. The results of these calculations are
shown as a nomogram.

539.1

7489 VACUUM SUBLIMATION APPARATUS FOR PREPARATION OF THIN SOURCES OF α-ACTIVE MATERIALS. N.Jackson.

J. sci. Instrum., Vol. 37, No. 5, 169-71 (May, 1960).

A method is described for preparing sources for α-pulse anal
by subliming the oxide at 2000° C from a tantalum filament. Sourc
so prepared gave good uniform resolution with a peak at half heigh
of 35 keV or better.

539.1

7490 MEASUREMENT OF H^3 AND C^{14} WITH A LIQUID SCINTILLATION COUNTER.

T.Higashimura, T.Iwakura and T.Sidei.
J. appl. Phys. Japan, Vol. 29, No. 1, 20-7 (Jan., 1960). In Japanes

A liquid scintillation counter for measuring low level C^{14} and I
beta activities has been constructed and its performance character
istics studied. The instrument is of the coincidence type. Scintilla
tions induced in the sample, usually 140 cm^3 in volume, contained i
Terex glass ampoules, are observed with two photomultipliers (EMI 6262). The output pulses are fed to two respective linear amplifiers (gain 10 000) and the coincidence count is taken. For reducing background count, the output of the coincidence circuit is
anti-coincidenced with the pulses that passed through the upper discriminator. The resolving time of the coincidence was 0.2 μse
and as for the stability of the circuit in measuring C^{14}, the variatio
of the counting efficiency was 1% in 24 hours. The counting efficiency of the instrument was of the order of 10% for H^3 and abo
40% for C^{14}. For measuring the distribution of C^{14} in nature, quenching of various organic materials was studied. Ethanol is on
of the best samples, for the quenching is not large and its preparat
is easy. Various side-effects are also studied, such as (1) the temperature dependency of the thermal noise of the photomultiplie
(2) the increase of the dark noise of the photomultiplier after being exposed to light of the room, (3) the phosphorescence of the glass ampoule and that of the reflector, (4) the effect of the ampoule material on the background counting rate.

539.1

7491 ${}^{90}Sr$-${}^{90}Y$ BETA-RAY APPLICATOR CALIBRATION. R.I.Weller.

J. nuclear Energy, Vol. 6, No. 4, 331-7 (May, 1958).

A 125 mc $Sr^{90} + Y^{90}$ beta applicator was calibrated with an extrapolation ionization chamber and by the use of nuclear film. Surface and depth doses determined by the two methods were in go
agreement. Using a polystyrene phantom, the surface dose was found to be 26.2 e.s.u. cm^{-3} sec^{-1}, or 1430 rad/min, with an estima
accuracy of ±3%. The half-value thickness was determined to be 0.13 cm.

539.1

7492 DETERMINATION OF ABSOLUTE RATE OF β-DISINTEGRATION FROM A P^{32}-SOURCE USING THE 4π-COUNTER TECHNIQUE. N.K.Saha and N.Nath.

Proc. Nat. Inst. Sci. India A, Vol. 22, No. 2, 98-104 (1956).

A preliminary report is presented for absolute measurement
β-ray disintegration rate by using a 4π-type of counter and coincid

method. The principle involved in the counter working and the simplification introduced in the elimination of the usual sources of error of β-ray counting and the present limitations of the method are discussed. A radiophosphorous P^{32} source prepared in the laboratory shows a source strength of 1.6 ± 0.2 μcurie per gramme and a mean disintegration rate of 3930 ± 60 c/min per 1.1 mg of the active salt is measured by this method.

539.16

7493 INDIVIDUAL DETECTION OF β-PARTICLES WITH GERMANIUM AND SILICON JUNCTION DIODES.

H.D.Engler.

Z. Naturforsch., Vol. 15a, No. 1, 82-4 (Jan., 1960). In German.

The construction of Ge and Si semiconductor diodes for β-radiation detection is described and pulse amplitude distribution curves of Tl^{204} betas (E_{max} = 0.76 MeV) are shown for a Ge diode at liquid-nitrogen temperature and for a Si diode at room and liquid-N_2 temperatures. The β-spectra were obtained with a linear amplifier of gain 8×10^4 and a 60-channel pulse amplitude analyser.

I.C.Demetsopoullos

539.16

7494 A POWERFUL γ-SOURCE WITH AUTOMATIC CONTROL.

F.G.Firsov.

J. nuclear Energy, Vol. 5, No. 3-4, 425-6 (1957). English translation of article in Atomanaya Energiya, Vol. 2, 182-4 (1957).

A convenient and simple construction for a Co^{60} source of 1000 c activity (equivalent to 1600 g of Ra) is described.

539.16

7495 THE STANDARDISATION OF RADIOISOTOPES — MEASUREMENT OF DECAY-PERIODS USING A VIBRATING REED ELECTROMETER.

A.Pierroux, G.Guében and J.Govaerts.

Bull. Soc. Roy. Sci. Liege, Vol. 28, No. 7-8, 180-7 (July-Aug., 1959). In French.

The decay periods of Fe^{59}, Eu^{155} and Nb^{95} have been measured as 45.60 ± 0.08 d, 1.811 ± 0.002 yr and 35.58 ± 0.42 d respectively.

A.E.I.Research Laboratory

539 16 : 537.52

7496 PRELIMINARY EXPERIMENTS ON RADIOACTIVITIES CONSEQUENT TO THE EXPLOSION OF WIRES CONTAINING DEUTERIUM.

M.Bonpas, A.Ertaud, J.P.Legrand and R.Meunier.

J. Phys. Radium, Vol. 18, No. 10, 585-92 (Oct., 1957). In French.

In preliminary experiments made in 1952-1953, studying high temperature production processes, thin wires were exploded by means of electrical discharges. The neutron emission produced during the explosion was measured by manganese activation. Following the discharge, in the vicinity of the electrodes supporting the wire, a radioactivity was found which decomposed in two periods: 38 ± 1 min, and 5 ± 1 min. These two periods can be assigned respectively to Zn^{63} and Cu^{66} produced from the brass of the electrodes. If it seems experimentally well established that nuclear reactions have been produced; their interpretation is however rather uncertain.

539.16

7497 EXPERIMENTS ON PRODUCTION OF THE 102-ND ELEMENT.

G.N.Flerov, S.N.Polikanov, A.S.Karamyan, A.S.Pasyuk, D.M.Parfanovich, N.I.Tarantin, V.A.Karnaukhov, V.A.Druin, V.V.Volkov, A.M.Semchinova, Yu.Ts.Oganesyan, V.I.Khalizev, G.I.Khlebnikov, B.F.Myasoedov and K.A.Gavrilov.

Zh. eksper. teor. Fiz., Vol. 38, No. 1, 82-94 (Jan., 1960). In Russian.

Results of new experiments on production of the 102-nd element (nobelium) and investigation of its nuclear properties are described. Pu^{241} and Pu^{239} targets were irradiated by O^{16} accelerated ions; nuclear emulsion was used to record radioactive decay of 102-nd element atoms. Alpha-decay of the isotope obtained (most probably 102^{253}) was observed with a half-life between 2 and 40 sec and α-particle energy of 8.9 ± 0.4 MeV. Careful analysis of possible background sources indicated that the background level is much lower than the effect observed.

539.16

7498 ON THE PRODUCTION OF ELEMENT 102.

P.R.Fields, A.M.Friedman, J.Milsted, H.Atterling, W.Forsling, L.W.Holm and B.Åström.

Ark. Fys., Vol. 15, Paper 18, 225-8 (1959).

In 1957 the authors reported the production of an isotope of element 102. By similar experiments made at Berkeley and in Moscow alpha disintegrations attributed to this element have also been found. At Berkeley, attempts to reproduce the results were unsuccessful. This has prompted the authors to make a thorough re-examination of their own experimental data. The purpose of this paper is to comment on some comparisons between the Berkeley and the Stockholm experiments. The re-investigation has not led to any new conclusions regarding the earlier interpretation of the results.

539.16 : 551.5

7499 CONTEMPORARY CARBON-14 IN LEMONGRASS OIL.

F.N.Hayes, E.Hansbury, V.N.Kerr and D.L.Williams.

Z. Phys., Vol. 158, No. 3, 374-8 (1960).

Liquid scintillation counting of p-cymene, derived from lemongrass oil, has provided information on the world-wide increase in C^{14} since 1954. By June 1959, the activity in the tropospheric atmosphere and in the rapidly equilibrating biosphere is measured to have increased by 26.8% in the northern hemisphere and 19.7% in the southern hemisphere. The shape of the relationship between activity and time is esentially linear, with two sections of quite different slope.

539.16

7500 S^{35} AND Be^7 CONTENTS IN RAIN AND SNOW.

R.Nilsson, I.Olsson, A.Berggren and K.Siegbahn.

Ark. Geofys., Vol. 3, Paper 7, 111-22 (1959).

The contents of S^{35} and Be^7 have been measured in some rain and snow samples from Uppsala and Abisko. The average concentrations of S^{35} were 230 and 175 atoms/cm^3, and of Be^7 1500 and 3000 atoms/cm^3 respectively. Calculations of the production rate of Be^7 have been made for different locations, where measurements of Be^7 activity have been carried out. The theoretical calculations agree at least qualitatively with the experimental data, and it would appear that the deposition rate is influenced by the variation of the tropopause height with latitude and season.

539.16

7501 OCCURRENCE OF SCANDIUM-46 AND CESIUM-134 IN RADIOACTIVE FALLOUT.

H.L.Krieger and J.Groche.

Science, Vol. 131, 40-42 (Jan. 1, 1960).

Two hitherto unreported induced radionuclides, and Sc^{46} and Cs^{134} were detected in fallout material. Identification was made by chemical separation and gamma scintillation spectrometry. While the origin of these materials is not known, possible routes of formation from stable elements are suggested.

539.16

7502 RADIOSTRONTIUM IN SOIL, GRASS, MILK AND BONE IN U.K.; 1956 RESULTS.

F.J.Bryant, A.C.Chamberlain, A.Morgan and G.S.Spicer.

J. nuclear Energy, Vol. 6, No. 1-2, 22-40 (1957).

The results of Sr^{90} analysis of soil, grass and sheep bone from twelve stations in England and Wales are given. The Sr^{90} in the top 4 in. of undisturbed soil in July 1956 ranged from 1.9 to 10.0 mc/km^2, depending on the rainfall. The Sr^{90} activity of herbage and of sheep bone showed a wider range, samples from acid hill soils being relatively more active. Milk from Somerset had a median activity of 4.4 $\mu\mu c$ Sr^{90}/g Ca in 1956, compared with 4.1 in 1955. Human-bone specimens obtained in 1956 showed Sr^{90} activity depending on age. The average level in children under 5 was 0.7 $\mu\mu c$ Sr^{90}/g Ca and the average bone dose 2 mrad/year.

539.16 : 539.17

EVIDENCE FOR SOME NEW ISOMERIC STATES. See Abstr. 5783

539.16

7503 EXCITATION OF VIBRATIONAL LEVELS AND COULOMB EXCITATION IN α-DECAY.

V.M.Strutinskii.

Zh. eksper. teor. Fiz., Vol. 38, No. 1, 122-33 (Jan., 1960). In Russian.

The relative probability of excitation of vibrational levels in the α-decay of even-even nuclei is calculated. An expression for the intensity of excitation of the daughter nucleus by α-particles of the main (allowed) group is derived in the quasi-classical perturbation theory approximation. The results obtained are applied to an analysis of the experimental data on the fine structure of α-decay.

539.16

7504 ALPHA-EMITTERS WITH SHORT HALF-LIFE INDUCED BY PROTONS ON HEAVY ELEMENTS.

P.A.Tove.

Ark. Fys., Vol. 13, Paper 40, 549-78 (1958).

Alpha-emitters with short lifetimes were produced by pulsed bombardment in a synchrocyclotron. The energies were measured with the help of the magnetic field of cyclotron, and the decay times with an electronic time analyser. New data for α-emitters in the region between uranium and bismuth are presented. The results from bombardment of thorium agree with previous information about the Th^{224} and Th^{223} series, and yield half-lives for Th^{224} and Th^{223} of, respectively, 1.05 ± 0.05 sec and 0.9 ± 0.1 sec. Information about further α-peaks in the 1 sec region is obtained and the possibility that these are due to the Pa^{224} and Pa^{225} decay series is discussed. The main result from irradiations of Ra is a check of previous data, yielding nuclei with half-lives in the range 0.5 to 40 sec. No α-emitters with lifetimes in the second region were obtained from uranium, lead, thallium, gold and platinum targets. Bombardments of bismuth yield four new α-emitters which from α-systematics are assigned to Po isotopes $Po^{196-192}$.

539.16

7505 BETA SPECTRA OF THE MIRROR NUCLEI.

R.Wallace and J.A.Welch, Jr.

Phys. Rev., Vol. 117, No. 5, 1297-305 (March 1, 1960).

The positron spectra anf half-lives of all the mirror nuclei ($2Z = A \pm 1$) with $19 \leq A \leq 39$ were systematically measured with a 180° deflection uniform-magnetic-field spectrometer. The ground-state transition energies were used to compute Coulomb-energy differences between mirror pairs. Deviations of these Coulomb-energy differences from a smooth variation with A are explained by a nuclear shell model using the potential well of an isotropic harmonic oscillator. The data support a symmetry for the proton wave-functions characteristic of the state of lowest seniority, with magic-number effects at A = 14 and 16 as well as A = 8 and 20. Comparison of the ft values obtained with experimental nuclear magnetic moments gives the following values for the partial coupling constants for the Fermi and Gamow–Teller β interactions: $g_F^2 = (1.5 \pm 0.1) \times \times 10^{-4}\,sec^{-1}$, $g_{GT}^2 = (2.2 \pm 0.1) \times 10^{-4}\,sec^{-1}$. Nuclear radii from μ-mesic atoms, when properly interpreted, are shown to be in agreement with radii deduced from Coulomb energy differences.

539.16

7506 EFFECT OF MASS SPLITTINGS ON THE CONSERVED VECTOR CURRENT. R.E.Behrends and A.Sirlin.

Phys. Rev. Letters, Vol. 4, No. 4, 186-7 (Feb. 15, 1960).

The effect of multiplet mass splittings on the conserved vector current theory of β-decay is considered. Theorems are proved which show that the corrections to the matrix element are second-order in the mass differences and so can be neglected.

J.Goldstone

539.16

7507 DOUBLE BETA DECAY.

L.Meichsner.

Phys. Rev., Vol. 117, No. 2, 489-91 (Jan. 15, 1960).

Formulae are given for the probability of double β-decay including energy distributions and angular correlations of the emitted electrons according to the theory of Feynman and Gell-Mann (Abstr. 507 of 1958). A strong dependence on the change of angular momentum exists. The formulae also exhibit interference between different intermediate states. The half-life of Ca^{28} is calculated using matrix elements of j–j shell-model configurations. It is found to be $t \sim 10^{17} \ldots 10^{20}$ years. Actually, t will be much greater, since the matrix elements used are those of favoured transitions.

539.16 : 539.17

7508 BRANCHING RATIO OF ^{242m}Am DECAY.

R.W.Hoff, E.K.Hulet and M.C.Michel.

J. nuclear Energy, Vol. 8, No. 4, 224-8 (Jan., 1959).

The branching ratio, $\beta^-/EC = 5.1 \pm 0.1$, for Am^{242m} decay has been measured by determining the relative amounts of the decay products, Cm^{242} and Pu^{242}, formed. The 16 hour Am^{242m} was produced by neutron irradiation of Am^{241} in the Materials Testing Reactor. A pile neutron cross-section of 620 ± 65 barns for the reaction $Am^{241}(n,\gamma)\,Am^{242m}$ was measured.

539.16

7509 INVESTIGATION OF THE DECAY $Bi^{212}(ThC) \xrightarrow{\beta} Po^{212}(ThC') \xrightarrow{\alpha} Pb^{208}(ThD)$ BY MEANS OF (γ,α)-COINCIDENCES. U.Hauser and W.Kerler.

Z. Phys., Vol. 158, No. 4, 405-16 (1960). In German.

The γ-spectrum of Po^{212} was measured by (γ,α)-coincidences with a fast–slow coincidence apparatus. The results are in excellent agreement with the conversion lines found by the Latyshev gr (Abstr. 6241 of 1958). The absolute γ-intensities were also determined in order to get the spins and parities of the levels by calculating the absolute conversion coefficients. The β-intensity leadin to the excited states of Po^{212} is estimated to be about one third of that measured by Burde and Rozner (Abstr. 8132 of 1957) by (β,α)-coincidences. Three γ-lines measured by Chinaglia and Demichelis (Abstr. 5326 of 1958) by (γ,α)-coincidences do not agre with the present results. The 2^+ assignment of the first excited state is now well established, but for the other levels in the decay scheme there is still some uncertainty concerning spin and level assignment.

539.1

7510 $_{77}Ir^{194m}$, A NEW NUCLEAR ISOMER WITH A HALF-LINE OF $T_{1/2}$ = 47 SEC.

H.H.Hennies and A.Flammersfeld.

Naturwissenschaften, Vol. 47, No. 1, 11-12 (1960). In German.

Describes preliminary attempts to assign the weak β activity observed in the decay of the Ir^{192} isomer with $T_{1/2}$ = 1.42 min to the presence of a new nuclear isomer, Ir^{194m}. S.J.St-Lora

539.1

7511 DECAY SCHEME AND β-SPECTRUM OF MsTH1 (Ra^{228}

G.Goetze.

Z. Phys., Vol. 158, No. 3, 347-58 (1960). In German.

The β-spectrum was measured in a proportional counter in 2π- and in 4π-geometry. Comparison of these measurements show that there are no conversion electrons. The β-decay of MsTh 1 therefore leads in all cases to the ground level of MsTh 2. The Ku plot is straight from 15 keV up to the upper energy limit of $E_0 = 55 + 3$ keV (log ft = 5.6). The result was checked by a search for photons emitted by the MsTh 1. No γ-rays and no X-rays were found. The measurements had to be made with a relatively large amount of natural Ra^{226} in the sources. The results do not agree with those of Lecoin, Perey, Teillac and Riou (1949) who proposed a complex decay scheme for MsTh 1.

539.1

7512 THE DECAY OF ^{147}Pm.

R.Jakeways and W.G.V.Rosser.

Proc. Phys. Soc., Vol. 74, Pt 4, 478-9 (Oct. 1, 1959).

β-γ coincidence measurements were used to show that the 121 keV γ-ray from a Pm^{147} source could not be due to β-decay to an excited state of Sm^{147} at 121 keV. The γ-rays were found to be associated with β-rays having an end point of 2.0 ± 0.2 MeV. Thes cannot arise from the decay of Pm^{147} so that the γ-rays must be due to some contamination in the source. A.Ashmor

539.16 : 539.1

7513 CALCULATION OF MATRIX ELEMENTS IN THE BETA-DECAYS OF Sc^{44} AND Mn^{52}.

P.S.Kelly and S.A.Moszkowski.

Z. Phys, Vol. 158, No. 3, 304-11 (1960).

Recent experiments make possible the approximate determina tion of mixing ratios $\int\sigma/\int 1$ for several nuclei in $J \rightarrow J$ beta transi tions. It is verified that the signs of these ratios in these two nucl are consistent with plausible assumptions about the nature of the nuclear wavefunctions, as determined using the j – j coupling nuclear shell model.

539.1

7514 LOW MASS ODD–ODD ISOMERS OF THALLIUM.

B.Jung and G.Andersson.

Nuclear Phys., Vol. 15, No. 1, 108-24 (Feb. [1], 1960).

β-spectrometer measurements on mass-separated sources fr synchrocyclotron bombardments of Hg and Tl with protons have yielded information about some previously unknown nuclides: (1.41 ± 0.02)hr Tl^{196m}, (11 ± 2)min Pb^{194}, (32.8 ± 0.2)min Tl^{194m}, and (33.0 ± 0.5)min Tl^{194}. Reinvestigation of the internal branch of (1.87 ± 0.03)hr Tl^{198m} has shown that it is more complex than assum earlier, suggesting the following level sequence: 7 + (544 keV), 3 – (283 keV), 2 – (260 keV), and 2 - (ground state). In Tl^{196} an analogous pattern is indicated: 7 + (395 keV), 3 – (275 keV), 2 – (241 keV), and 2 – (ground state). No internal branch has been found from Tl^{194m}, while about 4% I.T. can be calculated for Tl^{196m} and about 55% I.T. for Tl^{198m}. Some systematic energy level trend are discussed.

539.16

7515 BETA–GAMMA DIRECTIONAL CORRELATION IN THE DECAY OF Co^{60} AND Na^{22}.

H.Daniel and G.W.Eakins.

Phys. Rev., Vol. 117, No. 6, 1565-7 (March 15, 1960).

The differential and integral beta–gamma directional correlations in the decay of Co^{60} and Na^{22} were measured with scintillation counters. Both beta transitions are allowed but have high ft values. Therefore, small anisotropies are not excluded. In the case of Co^{60} the anisotropy was found to be zero for all beta energies above 0.06 MeV; the integral anisotropy was measured to be $A = -0.0003 \pm 0.0017$ (standard deviation). In the case of Na^{22} the results seem to indicate an energy dependence of the anisotropy; the value is uncertain because of coincidences between positrons and annihilation quanta.

539.16

7516 MEASUREMENT OF THE VELOCITY DEPENDENCE OF THE $\beta-\gamma$ CIRCULAR CORRELATION IN Co^{60}.

P.Jäger

Z. Phys., Vol. 158, No. 2, 214-25 (1960). In German.

Describes the measurement of the circular polarization of the γ-rays following β-decay of Co^{60} for two values of v/c of the electron. The β-particle energy was measured with a thin-lens magnetic spectrometer and the polarization of the γ-rays was measured by scattering in magnetized iron. Pulses from the two detectors were fed into a fast–slow coincidence unit of resolution time about 6 nanosec. The results obtained for values of v/c of 0.51 and 0.69 are in agreement with theory within the experimental errors. R.H.Thomas

539.16

7517 ON THE DETERMINATION OF ABSOLUTE INTERNAL CONVERSION COEFFICIENTS BY THE COMPARISON OF CONVERSION LINES AND PHOTOLINES. AN APPLICATION TO THE 662 keV TRANSITION IN THE DECAY OF Cs^{137}.

S.Hultberg and R.Stockendal.

Ark. Fys., Vol. 14, Paper 36, 565-77 (1959).

The method for the determination of absolute values of internal conversion coefficients by the beta-spectrometric comparison of conversion line and photoline intensities has been studied. The deduction of gamma-ray intensities from measured photolines is treated and it is shown that experimentally determined photoelectric distributions can be used in the theoretical formulae to a good approximation. The instrument used is a flat double-focusing beta-ray spectrometer and general expressions are given for a source-convertor assembly of cylindrical symmetry about the spectrometer axis. An application was made to the 662 keV M4 transition in Ba^{137} and the conversion coefficient was found to be 0.093 ± 0.006. A 2.19 ± 0.02 mg/cm^2 uranium convertor was used.

539.16

7518 CIRCULAR POLARIZATION OF THE INTERNAL BREMSSTRAHLUNG ACCOMPANYING K-CAPTURE IN Fe^{55}.

V.P.Parfenova.

Zh. eksper. teor. Fiz., Vol. 38, No. 1, 56-9 (Jan., 1960). In Russian.

The circular polarization of the internal bremsstrahlung accompanying K-capture in Fe^{55} was measured by scattering in magnetized iron. The technique of the measurements was based on the azimuthal dependence of the Compton scattering cross-section of gamma-quanta on polarized electrons. Within the limits of experimental error, 100% polarization of the bremsstrahlung quanta was obtained independent of the radiation energy.

539.16

7519 ON THE K-CONVERSION COEFFICIENT OF THE 279 keV GAMMA RAY IN THE DECAY OF Hg^{203}.

M.K.Ramaswamy and P.S.Jastram.

Nuclear Phys., Vol. 15, No. 3, 510-12 (March [1], 1960).

The K-conversion coefficient of the 279 keV gamma-ray following the beta-decay of Hg^{203} was measured by comparing the X-ray and gamma-ray intensities in a scintillation spectrometer. The measured value of $\alpha_K = 0.195 \pm 0.014$ indicates that the transition is M1 with E2 mixed to the extent of 63%. This value is considerably higher than the magnetic beta-spectrometer determinations, but it is in agreement with the results of Johansson using the scintillation method.

539.16

7520 THE TRANSITION ENERGY IN THE DECAY OF ^{202}Tl.

L.Blok, T.J.De Boer and J.Blok.

Physica, Vol. 25, No. 4, 333-6 (April, 1959).

The decay energy of Tl^{202} (12 d) was determined from the K/L capture ratio, measured by summation technique. With the help of the computations of Brysk and Rose (1955) the total transition energy is found to be 1100^{+400}_{-175} keV. From KX- and γ-ray intensity measurements and applying the equations of Marshak (Abstr. 1867 of 1942), it is concluded that $(7 \pm 10)\%$ of the electron capture transitions go direct to the ground state of Hg^{202}.

539.16

7521 AUGER TRANSITIONS IN Re^{183} AND THE M3 ISOMER IN Os^{189}.

J.O.Newton.

Phys. Rev., Vol. 117, No. 6, 1529-32 (March 15, 1960).

The rhenium KLL, KLM, KLN, and KLO Auger lines were observed in experiments on the decay of Os^{182} and Os^{183}. The measured energies are compared with those given by semi-empirical theories due to Bergström and Hill and to Asaad and Burhop; satisfactory agreement is found. A comparison of the measured intensities with those given by the nonrelativistic theory of Asaad and Burhop shows less satisfactory agreement. Conversion lines attributed to a previously reported M3 isomer in Os^{189} were observed and the transition energy found to be 30.81 ± 0.03 keV. L- and M-subshell ratios are reported. The transition appears to be hindered by a factor of 5×10^4 relative to the single-particle estimate.

539.16 : 539.14

7522 PROBABILITIES OF ELECTROMAGNETIC TRANSITIONS IN, AND STATIC MOMENTS OF ODD-ODD ATOMIC NUCLEI.

D.A.Varshalovich.

Zh. eksper. teor. Fiz., Vol. 38, No. 1, 172-9 (Jan., 1960). In Russian.

Formulae are given relating the probabilities of gamma-transitions with the static moments of odd-odd and neighbouring odd spherical nuclei, assuming multiplet level structure. A rule of relative intensities is established for transitions to multiplet levels, analogous to that for transitions to rotation band levels in deformed nuclei. This rule facilitates determination of the spins and state configurations of odd-odd nuclei. Examples are discussed. The correctness of the assumptions made is confirmed by satisfactory agreement between the experimental and theoretical values of the magnetic dipole moments for a large group of odd-odd nuclei.

539.16

7523 THE DECAY OF Au^{194}.

G.Bäckström, O.Bergman, J.Burde and J.Lindskog.

Nuclear Phys., Vol. 15, No. 4, 566-608 (March (2), 1960).

The decay of Au^{194} was investigated using high-resolution spectrometers for measurements of the conversion spectrum and a double-lens spectrometer for coincidence measurements. By careful analysis of the conversion spectrum, which was recorded at a resolution of $\approx 0.2\%$, it was possible to identify more than 100 transitions in Pt^{194}. The use of strong sources and a double counter operated in coincidence made possible the detection of lines of intensity only 10^{-5} times that of the strongest line. Multipolarities could be found from K/L ratios for a few low-energy transitions and some information could also be extracted from a comparison with results of previous gamma-ray work. Energies of the strongest lines were measured absolutely by means of an iron-free double-focusing instrument, and further energy determinations were made relative to these lines. The standard error of the measurements was frequently as low as 2 parts in 10^4. A complete set of energy sums was computed in order to survey the possibilities of cascade-crossover combinations. The reliability of the numerical relationships was investigated statistically, and it was shown that a reasonably unique level scheme could be constructed on the basis of energies, although the positions of transitions remained to some extent ambiguous. The results of 79 coincidence experiments are reported, and when analysed these data lead to a level scheme in agreement with the conclusions of the other approach. Furthermore, these experiments helped in deciding the location of transitions. Evidence for at least two 0^+ states was found. The discovery of a level at 923 keV, probably of 4^+ character, revealed a close analogy with the level scheme of Pt^{192}. The interpretation of this level as a three-phonon state is in agreement with theory.

539.16

7524 DECAY OF Os^{182} AND Os^{183}. I. GAMMA AND BETA SPECTROSCOPY.

J.O.Newton.

Phys. Rev., Vol. 117, No. 6, 1510-19 (March 15, 1960).

Four activities, produced by the bombardment of tungsten with alpha-particles having energies up to 48 MeV, were identified. They have half-lives of 9.9 ± 0.3, 13.67 ± 0.1, 21.1 ± 0.3, and >500 hours. From the excitation functions and other measurements these are attributed to the decay of Os^{183m}, Os^{183}, and Os^{185}, respectively.

Measurements on the gamma-ray spectra and conversion line spectra are reported. The spectra are complex, and a total of 251 conversion lines was observed. In many cases the decay of individual gamma-rays and conversion lines was studied.

539.16

7525 DECAY OF Os^{182} AND Os^{183}. II. COINCIDENCES, CONVERSION COEFFICIENTS, AND DECAY SCHEMES.

J.O.Newton.

Phys. Rev., Vol. 117, No. 6, 1520-8 (March 15, 1960).

The 382 keV transition in Re^{183} was shown to have a conversion coefficient of $(1.09 \pm 0.14) \times 10^{-2}$ which established the transition as E1. The half-life of the state from which this arises was found to be $(7.7 \pm 0.5) \times 10^{-9}$ sec from delayed coincidence measurements, indicating a hindrance factor of 3×10^{6} relative to the single particle value. Other transition multipolarities were assigned from their conversion coefficients, L subshell and K/L ratios as obtained from Pt 1 (preceding abstract). Amongst these the 170.72 keV isomeric transition in Os^{183} was identified and shown to be M4 with a hindrance factor of 12. Decay schemes for Os^{183} and Os^{183m} are established and good agreement is obtained between the proposed spins and parities and those suggested by the scheme of energy levels in a spheroidal potential as calculated by Nilsson.

539.16

7526 0+ STATES OF Sm^{152} AND Gd^{152}.

I.Marklund, O.Nathan and O.B.Nielsen.

Nuclear Phys., Vol. 15, No. 2, 199-215 (Feb. [2], 1960).

The decay of Eu^{152m} (9.2 hr) is studied by means of internal and external conversion and $e^- - \gamma$ coincidence measurements with particular interest focused on the possible low-lying 0+ levels in the transition region between spherical and non-spherical nuclei. Such levels are now found at 615.3 keV in the near-spherical nucleus Gd^{152} and at 685.0 keV in the strongly deformed nucleus Sm^{152}. The experimental K-conversion coefficients for the $0+ \rightarrow 0+$ transitions are ≥ 0.770 and ≥ 0.250, respectively. The e_K^-/γ branching ratios from the 0+ levels to the ground states and to the first excited 2+ states are compared with the theoretical values:

$$Gd^{152}: \ \mu_{exp} = 0.10 \pm 0.03 \quad \mu_{theory} = 0.085;$$
$$Sm^{152}: \ \mu_{exp} = 0.013 \pm 0.001, \quad \mu_{theory} = 0.13.$$

539.16

7527 Y^{90} DISINTEGRATION. $0^+ \rightarrow 0^+$ TRANSITION IN Zr^{90}. FIERZ'S TERM. I. $0^+ \rightarrow 0^+$ TRANSITION IN Zr^{90}.

T.Yuasa, J.Laberrigue-Frolow and L.Feuvrais.

J. Phys. Radium, Vol. 18, No. 8-9, 498-504 (Aug.-Sept., 1957). In French.

The existence of a $0^+ \rightarrow 0^+$ transition of 1.734 MeV in Zr^{90} is indicated. The results are in good agreement with theory. The values of the strength parameter ρ^2 obtained for $0^+ \rightarrow 0^+$ transitions are discussed and compared with those of other authors.

539.16

7528 II. STUDY OF THE INFLUENCE OF THE TERM OF FIERZ ON THE FORM OF THE β^- SPECTRUM OF Y^{90}.

T.Yuasa, J.Laberrigue-Frolow and L.Feuvrais.

J. Phys. Radium, Vol. 18, No. 10, 559-61 (Oct., 1957). In French.

The precise study of the form of the β^- spectrum of Y^{90} was used to evaluate the eventual participation of the interaction A as less than 3% of that of T in this disintegration: $\varphi < 0.03$.

539.16

7529 RELATIVE INTENSITIES OF SOME γ-TRANSITIONS OF Ac^{227}. R.Foucher.

C.R. Acad. Sci. (Paris), Vol. 250, No. 7, 1249-51 (Feb. 15, 1960). In French.

The relative intensity of γ-rays following de-excitation of particle levels of 329 keV was measured using a scintillation-counter spectrometer. From these measurements and determinations of the $\alpha - \gamma$ and $\gamma - \gamma$ coincidence rates the probable multipolarities of some γ-transitions in Ac^{227} are deduced.

R.H.Thomas

539.16

7530 RADIOACTIVE DECAY OF Ag^{110m}.

N.M.Anton'eva, A.A.Bashilov and E.K.Kulakovskii.

Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1497-505 (Dec., 1959). In Russian.

A magnetic spectrometer study was made of the photoelectron spectrum produced by the γ-rays of Ag^{110m}, and also of the β-ray spectrum up to an energy of 530 keV and the spectrum of conversion electrons corresponding to nuclear transitions with energies of 116 and 656 keV. The internal conversion coefficients for 14 nucle transitions in Cd^{110} and the multi-polarity of the radiation were determined on the basis of the relative line intensities listed in the present paper and those given in a previous paper. The decay scheme of Ag^{110} is discussed.

539.1

7531 GAMMA WIDTH IN Be^8 PERTINENT TO A TEST OF THE CONSERVED VECTOR CURRENT THEORY.

D.Kurath.

Phys. Rev. Letters, Vol. 4, No. 4, 180 (Feb. 15, 1960).

It is shown that the failure of experiments to reveal the $(\beta - \alpha)$) angular correlation predicted by the theory for mass eight nuclei, cannot be explained by an anomalously small M1 transition width between the states (J = 2, T = 1) and (J = 2, T = 0) in the nucleus B

S.J.Goldsac

539.1

7532 THE CIRCULAR POLARIZATION OF THE GAMMA RAYS FOLLOWING THE β DECAY OF Fe-59.

H.H.Forster and N.L.Sanders.

Nuclear Phys., Vol. 15, No. 4, 683-6 (March (2), 1960).

The circular polarization of the gamma-rays emitted in the beta-decay of Fe^{59} was measured using the method of forward scattering from a magnetized Armco iron cylinder. A method is described to separate the effects due to the two dominant decay modes. For the 461 keV β—1.099 MeV γ cascade an asymmetry coefficient $A = -0.46 \pm 0.08$ was determined; for the 271 keV β— 1.20 MeV γ transition the asymmetry coefficient was $A = -0.04 \pm 0.1$

539.1

7533 RESONANT ABSORPTION OF THE γ-RAYS FROM HOLMIUM 166 AND OSMIUM 193 WITHOUT NUCLEAR RECOIL.

A.Bussière de Nercy, M.Langevin and M.Spighel.

C.R. Acad. Sci. (Paris), Vol. 250, No. 6, 1031-3 (Feb. 8, 1960). In French.

Describes measurements of the absorption of γ-rays from Os^{1} Os^{191}, Ta^{182}, Ho^{166} and Sm^{153} by absorbers containing the daughter nucleus. Emission of the 80 keV γ-ray from Ho^{166} and the 73 keV γ-ray from Os^{193} is shown to take place without recoil of the nucleu Considerations of all the data indicate a disagreement with theoretical predictions for the fraction of emissions taking place without recoil — the discrepancy appearing to be related to the nuclear lifetime.

R.H.Thom

539.1

7534 RESONANCE SCATTERING OF ^{24}Mg γ-RAYS.

N.A.Burgov and Yu.V.Terekhov.

J. nuclear Energy, Vol. 7, No. 3-4, 247-54 (Sept., 1958). English translation of article in: Atomnaya Energiya, Vol. 2, 514 (1957).

Resonance scattering of the 1.38 MeV γ-ray from Mg^{24} has bee observed in metallic magnesium by means of a transmission measurement. The 1.38 MeV radiation is due to a transition from the first excited level to the ground state. The small loss of energy experienced by the γ-ray quantum owing to nuclear recoil at the tim of emission and to subsequent collisions with nuclei is compensate in some instances, by an energy increment due to the velocity whic the emitting nucleus has in virtue of the earlier emission of a 2.76 MeV γ-ray. Quanta of the correct energy for resonance scatte ing are therefore to be found in the decay radiation. Fast coincidences between γ-rays of the two energies, emitted by an aqueous solution of $Na^{24}OH$, were detected by a method involving pulse ampl tude analysers, and the transmission of the 1.38 MeV γ-ray by Mg and Al scatterers was measured as a function of the angle between the radiations. At an angle of 120°, agreeing with theory, a dip of half-width ~ 2½% was found in the transmission of Mg. The measu ments set a lower limit for the width of the 1.38 MeV level of Mg^{24} at 3.2×10^{-4} eV.

539.16 : 539.

GAMMA-RAY SPECTRUM OF Mn^{55}. See Abstr. 5798

539.

7535 GAMMA RAYS FOLLOWING THE DECAY OF Nd^{147} AND Sm^{153}.

T.J.Walters, J.H.Webber, N.C.Rasmussen and H.Mark.

Nuclear Phys., Vol. 15, No. 4, 653-6 (March (2), 1960).

A 2m radius bent quartz crystal spectrograph was used to stu gamma-rays following the β^--decay of Nd^{147} and Sm^{153}. A gamma ray of 91.05 ± 0.04 keV was observed following the decay of Nd^{147}. This gamma-ray corresponds to the transition between the first excited level and the ground state of the isotope Pm^{147}. Three gamma-rays were observed in the decay of Sm^{153}. Two strong lines at 103.17 ± 0.04 keV and 69.66 ± 0.02 keV correspond to short-lived isomeric levels in Eu^{153}. These have been observed previously. In addition, a weak line at 97.42 ± 0.04 keV was present. A line at approximately this energy has been observed in the electron capture decay of Gd^{153} to Eu^{153}. The intensity ratio of the 103.17 keV transition to the 97.42 keV line is greater than 20 to 1.

539.16

7536 THE ANGULAR CORRELATION BETWEEN SOME COINCIDENT γ-RAYS OF ^{192}Pt. D.K.Butt.

Proc. Phys. Soc., Vol. 75, Pt 1, 61-6 (Jan., 1960).

A re-investigation of the combined angular correlation existing between the 196, 308 and 316 keV γ-rays of Pt^{192} has been found to be in agreement with spin 3 for the 4th excited state and M1/E2 mixtures of about 3% and 5% for the 308 and 296 keV transitions respectively.

539.16

7537 GAMMA RAYS OF PROMETHIUM-152. A.H.W.Aten, Jr and G.Wolzak.

Physica, Vol. 25, No. 1, 50 (Jan., 1959).

The β^- decay of Pm^{152}, formed by an (n,p) reaction from enriched Sm^{152}, was observed using magnetic deflection to eliminate interfering β^+ activities, and a half-life of 5 ± 1 min found. Scintillation spectrometry showed γ-rays of 122 ± 2 and 245 ± 3 keV, identifiable with the γ-lines from K-capture in Eu^{152}, together with some γ rays of low intensity around 1 MeV.

A.E.I.Research Laboratory

539.16

7538 GAMMA RADIATION FOLLOWING THE DECAY OF ^{124}Sb AND ^{124}I. R.K.Girgis and R.Van Lieshout.

Physica, Vol. 25, No. 2, 133-48 (Feb., 1959).

The gamma radiation following the decay of 60 days Sb^{124} and 4.1 days I^{124} has been investigated with a scintillation spectrometer. A new gamma ray of 1900 keV has been found in the decay of Sb^{124}. Gamma rays of 605, 644, 725, 890, 970, 1055, 1320, 1370, 1450, 1510, 1695, 1900, 2090, 2260 and 2745 keV have been found in the decay of I^{124}. Relative intensities of the gamma rays are reported and a tentative level scheme for Te^{124} is proposed.

539.16 : 539.14

7539 GAMMA LINES ON THE DECAY OF ^{202}Tl. P.Born, J.Molenaar and J.Blok.

Physica, Vol. 25, No. 4, 326-32 (April, 1959).

The gamma-radiation of Tl^{202} was reinvestigated by means of a gamma-scintillation spectrometer. Two new gamma-lines were found of 523 and 965 keV. An estimation was made for the transition-energy to the ground state of Hg^{202} and a level scheme of Hg^{202} was set up. The ratio of the energies of the second and first excited states was compared with the values of neighbouring nuclei.

539.16

7540 THE NUCLEAR g-FACTOR OF THE 111 keV ROTATIONAL LEVEL AND OTHER ANGULAR CORRELATION MEASUREMENTS ON W^{184}.

E.Bodenstedt, E.Matthias, H.J.Körner, E.Gerdau, F.Frisius and D.Hovestadt.

Nuclear Phys., Vol. 15, No. 2, 239-53 (Feb. (2), 1960).

The angular correlations of the 793 keV — 111 keV cascade and the 895 keV — 111 keV cascade of W^{184} were found to be

$$W(\theta) = 1 - (0.036 \pm 0.004) \cdot P_2(\cos\theta) + (0.219 \pm 0.006) \cdot P_4(\cos\theta),$$

$$W(\theta) = 1 - (0.177 \pm 0.013) \cdot P_2(\cos\theta) + (0.043 \pm 0.024) \cdot P_4(\cos\theta),$$

respectively. The source was prepared as KReO$_4$ in a liquid solution. It was shown that the coefficients are "attenuated" by internal fields. The attenuation factors were: $G_2 = 0.54$ and $G_4 = 0.67$. These angular correlation results confirm the proposed spin values $I = 2$ for the 904 keV level and $I = 3$ for the 1006 keV level and identify the 793 keV and the 895 keV transitions as pure E2. A reinvestigation of the half-life of the 111 keV state gave $(1.28 \pm 0.08) \times 10^{-9}$ sec. The half-life of the mother isotope Re^{184} was found to be 38 ± 1 days, in disagreement with the earlier value of 50 ± 2 days. The nuclear g-factor of the 111 keV rotational level was obtained by determining the rotation of the 793 keV — 111 keV angular correlation in an external magnetic field of 36040 gauss. The result, $g = +0.38 \pm 0.05$, is in agreement with the prediction of the collective model $g_R = Z/A$.

NUCLEAR REACTIONS

539.17

7541 STATISTICAL MODELS FOR HIGH ENERGY NUCLEAR REACTIONS. I. M.Neuman.

An. Acad. Brasil. Cienc., Vol. 31, No. 3, 361-79 (1959).

Examines the foundation of such models. Starts with a Lorentz-covariant theory of the classical microcanonical ensemble, and discusses the quantum analogue.

R.J.N.Phillips

539.17

7542 THRESHOLD EFFECTS IN NUCLEAR REACTIONS. A.I.Baz.

Advances in Phys., Vol. 8, 349-74 (Oct., 1959).

The idea is explored that between the colliding particles or the reaction products of a nuclear reaction the interaction in the immediate neighbourhood of the nuclear surface may be represented by a static attractive potential. The Wigner—Eisenbud theory of nuclear reactions is readily reformulated to take this "surface potential" into account, whereupon quasi-bound states of the compound system are found to appear, with high probability, very close to the various thresholds for two-particle channels. Consequently, the cross-section of a reaction close to any threshold should have a certain resonance-like behaviour. The relevant experimental data are reviewed and are found to support all the predictions of the theory.

539.17

7543 EXTENSION OF THE BLATT—BIEDENHARN FORMALISM FOR RESONANCE REACTIONS.

H.Lustig.

Phys. Rev., Vol. 117, No. 5, 1317-24 (March 1, 1960).

The Blatt—Biedenharn formalism (Abstr. 1100 of 1953) for the calculation of cross-sections in resonance reactions is extended to provide for (1) empirical spin-orbit effects in the potential scattering, (2) the interference of resonances of unequal spin and/or parity, and (3) the energy spread of the incident particle. Explicit formulae are given for the total cross-section and for the Legendre polynomial expansion coefficients in the differential cross-section, for single channel elastic scattering, in the presence of all three effects. For a general multi-channel reaction, explicit reaction and elastic scattering formulae, both differential and total, are derived only for the second situation.

539.17

7544 INELASTIC SCATTERING OF NUCLEONS BY ASYMMETRICALLY DEFORMED NUCLEI. A COMMENT ON THE STRUCTURE OF MEDIUM WEIGHT NUCLEI.

H.Ui.

Nuclear Phys., Vol. 15, No. 3, 495-500 (March (1), 1960).

The inelastic scattering of nucleons by direct excitation of nuclear rotational states is investigated, in which the target nucleus is described by an asymmetric-top wave-function, as recently proposed by Davydov and Filippov. Then, in even nuclei, not only the first rotation state, but also another 2^+ rotation state can be excited by the first-order direct interaction. The cross-sections to these two states are presented as functions of the deformation parameters β and γ of A.Bohr. Brief discussions are also added in connection with the vibration model. It is pointed out that the measurement of these cross-sections and angular correlations between emitted nucleons and γ-rays would provide means for determining the structure of medium weight nuclei.

539.17

7545 SCATTERING OF FAST PROTONS BY NON-SPHERICAL NUCLEI. S.I.Drozdov.

J. nuclear Energy, Vol. 7, No. 3-4, 231-8 (Sept., 1958). English translation of article in: Atomnaya Energiya, Vol. 2, 501 (1957).

There is a substantial difference between the angular distributions of protons scattered by spherical and by non-spherical nuclei, and by comparing theoretical calculations with experiment the deviation of a nucleus from a spherical shape can be estimated. The scattering of fast protons by non-spherical nuclei is considered for the case where the proton energy is large compared with the Coulomb barrier energy ($E > 20$ MeV). Further, a "black" model of the nucleus and the adiabatic approximation are also assumed; then the effective scattering cross-sections can be found by determining the amplitude for scattering by a fixed nucleus. It is shown that the amplitude can be represented as a sum of the amplitudes for diffractive scattering and for scattering by the electric field of the nucleus. Both these amplitudes are derived assuming that the deviation of the nucleus from spherical shape is small ($\alpha_2 Ze^2/\hbar\nu \ll 1$). The angular distributions of protons scattered by even-even nuclei are evaluated.

539.17

7546 ELASTIC SCATTERING OF 8.7 BeV PROTONS ON PHOTOGRAPHIC EMULSION NUCLEI.

B.P.Bannik, V.G.Grishin, M.Ya.Danÿsh, V.B.Lyubimov and M.I.Podgoretskii.
Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1575-82 (Dec., 1959). In Russian.

Elastic scattering of 8.7 BeV protons on emulsion nuclei was studied by a special method. The measured angular distribution is in good agreement with that calculated on the basis of the optical model with allowance for refraction in the nucleus.

539.17

7547 (p,α) REACTIONS INDUCED BY PROTONS IN THE ENERGY RANGE OF 9.5-23 MeV.

C.B.Fulmer and C.D.Goodman.
Phys. Rev., Vol. 117, No. 5, 1339-44 (March 1, 1960).

An earlier study of (p,α) reactions induced by 23 MeV protons (Abstr. 3887 of 1959) has been extended by observing the outgoing alpha particles from nuclear reactions induced by protons of various energies between 9.5 and 23 MeV in numerous elements throughout the periodic table. Alpha-energy distributions and absolute differential (p,α) cross-sections were measured at 90 deg. From the integrals of the alpha-energy distributions, excitation functions for (p,α) reactions were determined. Excitation functions for (p,α) reactions in targets for which compound nuclei are integral numbers of alpha particles are qualitatively different from those of other targets. Alpha-energy distributions for targets with $Z < \sim 50$ (except for F and Al) are peaked at about the same energy for incident proton energies of 9.5-23 MeV; this may be interpreted as evidence that the Coulomb barrier is lowered for alpha-particle emission from excited compound nuclei.

539.17

7548 ENERGY AND ANGULAR DISTRIBUTIONS OF ALPHA PARTICLES FROM REACTIONS OF HIGH-ENERGY PROTONS WITH Ag AND Br NUCLEI.

E.W.Baker, S.Katcoff and C.P.Baker.
Phys. Rev., Vol. 117, No. 5, 1352-60 (March 1, 1960).

An investigation was made of the energy and angular distributions of α-particles emitted from silver and bromine nuclei in Ilford D-1 (200 μ) nuclear emulsions, during bombardments in the Brookhaven Cosmotron with 1.0-, 2.0-, and 3.0-BeV protons. The α-energies studied were in the interval from 0-50 MeV with particular emphasis placed on the low-energy region. An attempt was made to correct the observed spectra for the centre-of-mass motion of the emitting nucleus and then to compare these spectra with those calculated from nuclear evaporation theory. Two sets of centre-of-mass transformations were made. In one case the beam direction was considered to be that of the moving system, and in the second case the direction of the observed recoil was considered to be that of the moving system. Good agreement was obtained with the theoretical spectra throughout the energy region studied. An apparent excess of low-energy α-particles in the uncorrected spectra was removed by assuming that the emitting nucleus moves in the observed direction of the recoil at 0.015c at 1.0 BeV and 0.02c at 2.0 BeV. These velocities were consistent with the measured lengths of the observed recoil nuclei. Both the angular distributions of the recoil fragments and of the α-particles were consistent with random emission from this moving system. It seems likely, therefore, that one can, at the same time, explain the observed angular distributions and the low-energy α-particles by isotropic evaporation from a moving system.

539.17

7549 ANALYSIS OF ELASTIC CROSS SECTIONS AND POLARIZATION OF 10 MeV PROTONS.

J.S.Nodvik and D.S.Saxon.
Phys. Rev., Vol. 117, No. 6, 1539-44 (March 15, 1960).

The differential elastic cross-section and polarization of 10 MeV protons scattered by argon and copper have been analysed using a diffuse surface optical model potential with a spin-orbit term. The model parameters were varied systematically, the best fits with the experimental data being determined by a method of least squares. As in other analyses, it was found that almost equally good fits could be obtained over a range of values of the radius constant, R_0, in this case, for R_0 approximately between 1.20 and 1.30. Only the value of the real part of the central potential was markedly different for the best fits obtained for various R_0 in this range. The experimental polarization data is not precise enough to determine the spin-orbit potentials to within better than 1 or 2 MeV.

539.1

7550 PROTON CAPTURE IN Be^7.

R.W.Kavanagh.
Nuclear Phys., Vol. 15, No. 3, 411-20 (March (1), 1960).

Cross-sections for proton capture by Be^7 measured at bombard energies of 800 keV and 1400 keV are 0.48 ± 0.18 and 0.50 ± 0.20 microbarns, respectively, from which the corresponding cross-section factors are S = 0.027 ± 0.010 and 0.017 ± 0.007 keV. barns. The reaction is therefore important in stellar energy production onl in stars operating on the proton—proton chain at temperatures grea than about 2×10^7 deg. K.

539.1

7551 THE (p,n) REACTION ON LITHIUM AND THE GROUND STATE OF THE ^6Be NUCLEUS.

G.F.Bogdanov, N.A.Vlasov, S.P.Kalinin, B.V.Rybakov and V.A.Sidor
J. nuclear Energy, Vol. 8, No. 1-3, 148-55 (Nov., 1958). English translation of article in Atomnaya Energiya, Vol. 3, No. 9, 204 (1957

The time-of-flight method has been used to study the neutron spectra from the reactions of Li^6 and Li^7 with 9 MeV protons. Neutron groups were observed corresponding to transitions to the groun state of Be^6 and to the three lower states of Be^7, as well as a contin ous distribution of low-energy neutrons due to more complex reactions. Observation of the group of neutrons from the reaction $Li^6(p,n)Be^6$ is the first experimental evidence of the existence of the Be^6 nucleus. The Q-value of the reaction $Li^6(p,n)Be^6$ is equal to -5.2 MeV and the width of the ground state of Be^6 is less than 0.3 Me The differential cross-sections for neutron formation were measure at angles of 0, 15, 30, 60 and 120°.

539.17

7552 TOTAL REACTION CROSS SECTIONS OF SEVERAL NUCLEI FOR 61 MeV PROTONS.

V.Meyer, R.M Eisberg and R.F.Carlson.
Phys. Rev., Vol. 117, No. 5, 1334-6 (March 1, 1960).

The total reaction cross-sections of C, A, Fe, and Sn for 61 MeV protons were measured by a beam attenuation technique. This technique is described, and the results are presented and compared with total reaction cross-sections for neutrons and with optical model calculation.

539 1

7553 CROSS SECTION AND ASYMMETRY IN THE DEUTERO PICKUP REACTION $C^{12}(p,d)C^{11}$ AT 145 MeV.

P.F.Cooper, Jr and R.Wilson.
Nuclear Phys., Vol. 15, No. 2, 373-86 (Feb. [2], 1960).

A carbon target was bombarded with polarized protons of average energy 145 MeV and cross-sections and asymmetries were measured for deuterons emerging at angles between 5° and 40° to the incident beam. The asymmetry is small at angles less than 15°, but rises rapidly to become nearly 100% at 40°. The results for the cross-sections are in agreement with recent calculations including multiple-scattering corrections to the impulse approximation. They show that multiple-scattering effects dominate at large angles and prevent a search for high-momentum components by this method.

539.17 : 539.14

MOMENTUM DISTRIBUTION OF PROTONS IN CARBON.

See Abstr. 7443

539.1

7554 POLARIZATION IN $C^{12}(pp)$ SCATTERING.

J.E.Evans and M.A.Grace.
Nuclear Phys., Vol. 15, No. 4, 646-52 (March [2], 1960).

Measurements were made of polarization in $C^{12}(p,p)$ scattering at 60° (lab.) in the energy range 2.3-4.3 MeV. The results are significantly different from those derived from a phase-shift analysis and this can be explained by the extreme sensitivity of the polarization to small changes in the phase shifts. The experimental values then indicate a correction for the d-wave splitting.

539.1

7555 $C^{12}(p,pn)C^{11}$ CROSS SECTION FROM 3 TO 6 BeV.

N.Horwitz and J.J.Murray.
Phys. Rev., Vol. 117, No. 5, 1361-3 (March 1, 1960).

The cross-section was measured at proton energies of 3.0, 4.5, and 6.0 BeV. The measured values are 29.8 ± 1.6, 27.7 ± 1.7 and 29.8 ± 1.6 mb, respectively.

539.17

7556 ELASTIC SCATTERING OF PROTONS BY ISOTOPES OF CHROMIUM AT ENERGY 5.40 MeV.

A.P.Klyucharev and N.Ya.Rutkevich.

Zh. eksper. teor. Fiz., Vol. 38, No. 1, 285-7 (Jan., 1960). In Russian.

The angular distribution for the even—even nucleus Cr^{52} differs at large angles from that for the even—odd nucleus Cr^{53}. Similar differences have recently been observed in scattering from odd—even nuclei, e.g. Cu^{65}.

D.W.L.Sprung

539.17

7557 γ-RAY YIELD AND SPECTRA PRODUCED BY IRRADIATING BACKING MATERIALS WITH PROTONS.

S.E.Hunt, R.A.Pope, W.W.Evans and D.A.Hancock.

Brit. J. appl. Phys., Vol. 9, No. 11, 443-6 (Nov., 1958).

Thick targets of copper, silver, gold, tungsten, molybdenum, titanium, tantalum and tin were irradiated by protons in the energy range 0.6 to 2.8 MeV and the total γ-ray yield measured as a function of proton energy. The γ-ray spectra were also measured for a fixed proton energy of 2.2 MeV. The total γ-ray yields of the materials were found to decrease in the order given above, indicating that tungsten backings produce less total γ-ray background than any other. If high energy γ-rays are being investigated it may be advisable to use tin or gold backings since the γ-ray spectrum from these is concentrated towards the lower energies and can consequently be biased out in the counting equipment, but both materials are rather fragile under heavy proton irradiation.

539.17

7558 ON THE QUESTION OF $(p,\pi^{\pm})$ REACTIONS.

A.K.Lavrukhina.

Dokl. Akad. Nauk SSSR Vol. 129, No. 6, 1277-8 (Dec. 12, 1959). In Russian.

The occurence of reactions such as $Si^{30}(p,\pi^+)Si^{31}$ and $Cu^{65}(p,\pi^-)Ga^{66}$ for protons with energies between 200 and 660 MeV has been explained by assuming the existence of nucleons with high momentum in the nucleus. An alternative explanation is put forward here, that the bombarding proton collides with a peripheral meson in the meson cloud around one of the nucleons. It is pointed out that this model has been successfully used to analyse results at much higher energies, and that the cross-section for such a process should decrease rapidly below 1 GeV, in agreement with the experimental results. Study of similar reactions may provide deeper understanding of the peripherical collision process.

D.J.Thouless

539.17 : 539.14

7559 INELASTIC SCATTERING FROM ODD-MASS RARE EARTHS. M.C.Olesen and B.Elbek.

Nuclear Phys., Vol. 15, No. 1, 134-42 (Feb. [1], 1960).

The reduced electric quadrupole transition probabilities and excitation energies of the accessible low-lying states in Eu^{151}, Eu^{153}, Tb^{159}, Ho^{165}, Er^{167} and Tm^{169} were measured by Coulomb excitation with protons or deuterons having an initial energy of about 4.5 MeV. The measurements were performed on groups of inelastically scattered particles by means of a magnetic spectrograph, a method particularly suited for the determination of the absolute transition probability. The results are discussed in terms of the rotational model.

539.17

7560 ON THE EXCITATION FUNCTION FOR INTERNAL CONVERSION PAIRS AND γ-RAYS FROM THE REACTIONS $F^{19}(p,\alpha)O^{16}$ AND $Cd^{40}(p,p')Ca^{40}$.

S.Gorodetzky, G.Sutter, P.Chevallier, F.Scheibling and R.Armbruster.

C.R. Acad. Sci. (Paris), Vol. 250, No. 6, 1028-30 (Feb. 8, 1960). In French.

The excitation function has been determined for proton energies up to 5 MeV. The γ-rays and internal pairs were observed at 25° and 65° to the proton beam. The absence of γ-rays and the ratio of the pairs at the two observing angles were used to identify monopole pair emitting resonances.

L.L.Green

539.17

7561 PROTON CAPTURE BY N^{15}.

D.F.Hebbard.

Nuclear Phys., Vol. 15, No. 2, 289-315 (Feb. (2), 1960).

The cross-section for the reaction $N^{15}(p,\gamma_0)$ at protons energies below 700 keV was measured. The results fit well an analysis in terms of two interfering 1^- resonances at 338 and 1010 keV (12.43 MeV and 13.09 MeV respectively in O^{16*}), with destructive interference in the energy region between the resonances. The $N^{15}(p,\alpha_0)$ cross-section was analysed using the same parameters, with constructive interference between the resonances, and a good fit to the experimental cross-section was obtained. The values of S obtained by extrapolation to a proton energy of 25 keV (laboratory system) are 32 keV-barn and 7.2×10^4 keV-barn respectively for the $N^{15}(p,\gamma_0)$ and $N^{15}(p,\alpha_0)$ reactions. The angular distributions of the $N^{15}(p,\alpha_0)$ reaction were analysed. The presence of a 0^+ resonance near 500 keV proton energy, and a 2^+ resonance near 1000 keV proton energy, is indicated.

539.17

7562 REACTIONS OF PROTONS WITH Ni^{58} AND Ni^{60}.

S.Kaufman.

Phys. Rev., Vol. 117, No. 6, 1532-8 (March 15, 1960).

Excitation functions up to 19 MeV were measured for the $Ni^{58}(p,2p)$, $Ni^{58}(p,pn)$, and $Ni^{58}(p,\alpha)$ reactions, and for the $Ni^{60}(p,\alpha)$ reaction up to 13 MeV. The ratio of the (p,2p) cross-section to the (p,pn) cross-section is 3.5 at 19 MeV, and increases with decreasing energy. It is proposed that this excess of proton emission can be accounted for by nuclear evaporation theory, and a computer calculation of the excitation functions using this theory is described. The calculation reproduces the (p,2p) and (p,pn) curves quite well, and gives evidence that the compound nucleus mechanism probably applies to these reactions. The calculated (p,α) curve does not agree with the experimental results as well.

539.17

7563 ANGULAR DISTRIBUTION OF PROTONS, ELASTICALLY SCATTERED BY ISOTOPES OF NICKEL, COPPER AND COBALT AT ENERGY 5.45 MeV.

I.Ya.Rutkevich, V.Ya.Golovnya, A.K.Val'ter and A.P.Klyucharev.

Dokl. Akad. Nauk SSSR, Vol. 130, No. 5, 1008-11 (Feb. 11, 1960). In Russian.

The scattered protons were detected in nuclear emulsion plates 100 μ thick, arranged at 5° intervals around the target, and making a 15° angle with the scattered beam. The angular resolution varied from ± 5° at 160° to ± 34′ at 20° scattering angle. The distance r of each plate from the target was fixed so that $r(\text{Sin}\,\theta/2)^2$ was constant, to allow for Rutherford scattering. The elastically scattered group was well resolved in each case, having a half-width of ± 100 keV, which could be due to energy losses in target and emulsion. A significant difference was observed in the large-angle scattering, depending on whether the target was an even—even or an odd—even nucleus. This difference could not be fitted using an optical model potential which depends only on the mass number.

D.W.L.Sprung

539.17

7564 INELASTIC SCATTERING OF PROTONS BY ^{16}O.

L.Egardt and S.O.Lundqvist.

Ark Fys., Vol. 15, Paper 20, 237-40 (1959).

Differential cross-section and polarization are calculated as a function of angle for the inelastic scattering of 180 MeV protons for the 6.14 MeV level of O^{16}. The optical model potential is assumed to be central imaginary, and Gaussian in shape with a strength of 30 MeV. Treating the excited state in the L-S coupling scheme it is an excitation from the ground state S^4P^{12} (L = S = T = 0) to the excited state $S^4P^{11}D^1$ (L = 3, S = T = 0). The polarization is in good agreement with the experimental data of Tyrén and Maris (Abstr. 5341 of 1958) and Hillman, Johansson and Tyrén (Abstr. 5197 of 1958). Agreement on the differential cross-section is not so good and possible explanations of this are suggested.

A.Ashmore

539.17

7565 A DOUBLET RESONANCE IN THE REACTION $^{32}S(p,\gamma)^{33}Cl$. C.van der Leun and P.M.Endt.

Physica, Vol. 24, No. 12, 1095-101 (Dec., 1958).

Gamma-ray spectra, yields, and angular distributions have been measured with scintillation spectrometers at two resonances in the reaction $S^{32}(p,\gamma)Cl^{33}$, at 579.8 ± 1.5 keV and 587.4 ± 1.5 keV. The 580 keV resonance corresponds to a 2.85 ± 0.02 MeV level in Cl^{33} to which J = $5/2^+$ is assigned. This level decays almost exclusively to the ground state. The 587 keV resonance corresponds to a 2.86 ± 0.02 MeV level in Cl^{33} with spin J = $5/2^+$ which decays with approximately equal intensities to the ground state and to the first excited state at 0.806 ± 0.004 MeV. A Cl^{33} mass excess of

-11.2444 ± 0.011 MeV results from these experiments. The resonance strengths amount to $\gamma = 4.5 \pm 1.5$ meV for the 580 keV resonance, and to $\gamma = 26 \pm 10$ meV for the 587 keV resonance. A search for the conjugate state of the 2.94 MeV level in S^{33}, with $J = 7/2^-$, was unsuccessful.

539.17

7566 THE 367 keV RESONANCE IN $^{28}Si(p,\gamma)^{29}P$.
K.J.van Oostrum, J.Alster, N.Hazewindus and A.H.Wapstra.
Physica, Vol. 24, No. 12, 1051-4 (Dec., 1958).

A resonance is found in the gamma ray yield from the reaction $Si^{28}(p,\gamma)P^{29}$ at $E_p = 367 \pm 2$ keV. The excited level in P^{29} at (3.078 ± 0.009) MeV decays mainly by two cascades via the levels at (1.935 ± 0.020) and (1.380 ± 0.020) MeV to the ground state.

539.17

7567 THE POLARIZATION OF THE GAMMA-RADIATION FROM THE REACTION $Si^{30}(p,\gamma)P^{31}$.
P.M.Tutakin, S.P.Tsytko, A.N.L'vov, A.K.Walter and V.Iu.Gonchar.
J. nuclear Energy, Vol. 8, No. 4, 253-6 (Jan., 1959). English translation of article in: Atomnaya Energiya, Vol. 3, 10 (1957).

Measurements of the polarization of γ-rays have been used in the study of proton capture by light nuclei. The possibility of detecting the polarization of the γ-rays was apparent on finding the angular distribution of the γ-rays at proton-capture γ-resonances to be asymmetric. In the work reported here, the parity of the 8.2 MeV resonance in P^{31} has been determined as being positive by measuring the polarization of the γ-rays from the reaction $Si^{30}(p,\gamma)P^{31}$ at a proton energy of 940 keV. It had already been found that the 8.2 MeV level in P^{31} decays to the $J = \frac{1}{2}^+$ ground state not only by the direct γ-transition but also through intermediate levels at 1.26 and 2.35 MeV. The angular distribution of the 8.2 MeV γ-rays has the form $\omega(\theta) \sim 1 - a_2 \cos^2\theta$, where $a_2 = 0.60 \pm 0.15$, leading to the assignment J = 3/2 for the spin of the excited level of P^{31}.

539.17

7568 PROPERTIES OF THE EXCITED STATES OF Na^{22} FROM THE $Ne^{21}(p,\gamma)$ REACTION.
R.W.Krone and J.J.Singh.
Phys. Rev., Vol. 117, No. 6, 1562-4 (March 15, 1960).

Proton capture resonances in Ne^{21} were observed at 775 keV, 865 keV, 1010 keV, 1120 keV, 1215 keV, 1296 keV, and 1354 keV for proton bombarding energies ranging between 600 keV and 1500 keV. Pulse-height spectra of the resultant gamma-radiation are presented for the two lowest resonances. At the 776 keV resonance the transitions are predominantly to the ground state, whereas the 865 keV resonance seems to decay mainly to the 2.25 MeV state. Arguments are presented showing that this is consistent with identifying this level as the second T = 1, $J = 2^+$ state in Na^{22}.

539.17

7569 THE FORMATION OF ^{24}Na AND ^{32}P BY THE INTERACTION OF HIGH ENERGY PROTONS WITH COMPLEX NUCLEI. A.K.Lavrukhina, L.P.Moskaleva, L.D.Krasavina and I.M.Grechishcheva.
J. nuclear Energy, Vol. 8, No. 4, 231-8 (Jan., 1959). English translation of article in: Atomnaya Energiya, Vol. 3, 285 (1957).

The formation of Na^{24} and P^{32} by the interaction of high energy protons with Cu, La, Au and Th has been investigated. The dependence of the yields of Na^{24} and P^{32} on proton energy was studied radiochemically. Yields rise considerably with increase of the proton energy from 120 to 660 MeV and depend markedly on the atomic number of the target element. The calculated formation thresholds for Na^{24} and P^{32} in spallation and fission are compared with the experimental values showing that in Cu, La and Au these two nuclei are formed mainly by strongly asymmetric fission. Formation of P^{32} from Cu is an exception, being due to spallation, and this process is also important in the formation of Na^{24} from Cu.

539.17

7570 A GENERAL FORMULATION OF THE THEORY OF SURFACE REACTIONS WITH APPLICATION TO THE ANGULAR DISTRIBUTION OF STRIPPING REACTIONS.
H.A.Weidenmüller.
S.B. Heidelberg. Akad. Wiss. (math.nat.Kl.), 1959, No. 3, 24 pp. In German.

A formal theory of nuclear stripping reactions, taking antisymmetry and compound nucleus effects into account, is given. Certain plausible approximations are made, and it is shown that the amplitude reduces to the sum of two terms, the usual surface strippi term and a contribution from the inner region of the nucleus. The angular distributions obtained from this expression are given for a number of spin and parity assignments. E.J.Squires

539.17

7571 DEUTERON DISSOCIATION IN NUCLEAR SCATTERING
A.G.Sitenko.
J. nuclear Energy, Vol. 8, No. 4, 241-3 (Jan., 1959). English translation of article in : Atomnaya Energiya, Vol. 3, 324 (1957).

When a deuteron collides with a nucleus the processes that can occur are elastic scattering (d,d) inelastic scattering (d,d'), strippin (d,p) and (d,n) and dissociation (d,np). The theory of stripping reactions was worked out by Butler (Abstr. 8973 of 1951) who determined the angular distribution of the outgoing particles by use of the condition that the wave-functions are continuous at the surface of the nucleus. It was subsequently shown (Abstr. 6756 of 1952; 441 of 1953) that the Born approximation gives the same results as Butler' theory. Although it is difficult to justify the validity of the Born approximation for nuclear processes at energies around 10-15 MeV, its success in the case of the stripping reaction suggests the possibility of applying it also to other similar reactions. Huby and Newn (Abstr. 4598 of 1952) have discussed the inelastic scattering of deuterons and their results agree with experiment. In the present note the application of Born's approximation to the dissociation reaction is considered.

539.17

7572 THE INELASTIC SCATTERING OF DEUTERONS FROM ^{12}C. W.M.Fairbairn.
Nuclear Phys., Vol. 15, No. 4, 678-82 (March (2), 1960).

The angular distribution of deuterons scattered inelastically from C^{12} was determined using a direct interaction theory which assumes the excitation of a single one-particle level in the intermediate state. Comparison is made with the experimental data for two bombarding energies. The agreement is good and the method could be extended to other nuclei to obtain information about nuclear structure.

539.17 : 539.14

EXCITED STATES IN N^{14} FROM $C^{12}(d,d)C^{12}$, $C^{12}(d,p_0)C^{13}$, AND $C^{12}(d,p_1)C^{13*}$. See Abstr. 7474

539.17

7573 ANGULAR DISTRIBUTION OF PROTONS FROM THE REACTION $Ca^{40}(d,p)Ca^{41}$.
N.I.Zaika, O.F.Nemets and V.S.Prokopenko.
Zh. eksper. teor Fiz., Vol. 38, No. 1, 287-9 (Jan., 1960). In Russian

The experiment, carried out with 13.6 MeV deuterons, yielded angular distributions for transitions to the ground state and two excited states. These agree well with Butler stripping theory.
D.W.L.Sprung

539.17

7574 THE $Li^7(d,p)Li^8$ CROSS-SECTION AS A FUNCTION OF DEUTERON ENERGY IN THE RANGE 1.1-4 MeV.
L.S.Bezrukov, D.A.Panov and D.V.Timoshuk.
J. nuclear Energy, Vol. 4, No. 4, 521-3 (April, 1957). English translation of article in : Atomnaya Energiya, Vol. 1, No. 4, 149 (1956).

The β-activity of the Li^8 produced in a Li^7F target was measure during three successive intervals of 1 sec after a 1 sec deuteron exposure. Resonances at deuteron energies of 2.0, 2.5 and 3.7 MeV correspond to levels in the Be^9 nucleus with energies 18.3, 18.7 and 19.6 MeV. E.J.Burge

539.17

7575 ANGULAR DISTRIBUTION OF PROTONS FROM $Li^6(d,p)Li^7$ AND $Li^6(d,p)Li^{7*}$. G.O.André.
Nuclear Phys., Vol. 15, No. 3, 464-8 (March [1], 1960).

The angular distribution of protons from $Li^6(d,p)Li^7$ and $Li^6(d,p)Li^{7*}$ was measured, and the intermediate coupling parameter is calculated.

539.17

7576 THE SHAPE OF THE EXCITATION CURVE FOR THE $T(d,n)^4He$ REACTION.
V.A.Davidenko, I.S.Pogrebov and A.I.Saukov.
J. nuclear Energy, Vol. 6, No. 3, 258-60 (1958). English translation of article in: Atomnaya Energiya, Vol. 2, 386 (1957).

The deuterium ions were accelerated in an accelerator tube an selected by a magnetic analyser. Measurements were carried out on thick and on thin zirconium–tritium targets using deuterons in the energy range 40-225 keV.

539.17

7577 THE ^{51}V(d,p)^{52}V REACTION.
A.W.Dalton, A.Kirk, G.Parry and H.D.Scott.
Proc. Phys. Soc., Vol. 75, Pt 1, 95-101 (Jan., 1960).

The energy spectra of the protons emitted from a vanadium target when bombarded by 8.9 MeV deuterons have been measured by magnetic analysis at angles of observation between 5^0 and 70^0. The angular distributions of sixteen proton groups have been measured and compared with theoretical stripping curves to obtain information on parities, spins and reduced widths. Most of the transitions required an $l = 1$ assignment. The results are compared with results on the $V^{51}(n,\gamma)V^{52}$ reaction.

539.17

7578 SOME ANGULAR DISTRIBUTION MEASUREMENTS ON THE REACTIONS ^{16}O(^{3}He,d) ^{17}F and ^{16}O (^{3}He, α) ^{15}O.
S.Hinds and R.Middleton.
Proc. Phys. Soc., Vol. 74, Pt 6, 775-9 (Dec., 1959).

At 9.16 MeV bombarding energy the α-particle angular distributions indicate pick-up to the ground and first-excited states of O^{15}, and stripping to the ground state of F^{17}. The second excited state of O^{15} appears not to be formed by a pick-up process. The shell model interpretation of the results is discussed. Measurements on $O^{16}(He^3, \alpha)\, O^{15}$ at bombarding energies from 5.6-6.0 MeV show resonance effects in the excitation function and interference effects in the angular distributions. It appears that up to 6 MeV, compound nucleus formation competes strongly with direct processes.

A.Ashmore

539.17

7579 ANALYSIS OF ALPHA-PARTICLE ELASTIC SCATTERING EXPERIMENTS.
J.A.McIntyre, K.H Wang and L.C.Becker.
Phys. Rev., Vol. 117, No. 5, 1337-8 (March 1, 1960).

By a simple modification of the sharp cutoff (Blair) approximation (Abstr. 10488 of 1954) a phase-shift analysis was found to reproduce the experimental alpha-particle elastic scattering data from silver. Only two adjustable parameters were required to fit the experimental data for 22 MeV scattering (Abstr. 3089 of 1955); four parameters were used for the 40 MeV data (Abstr. 3190 of 1956). The uniqueness of the fits was not determined.

539.17

7580 CROSS-SECTIONS FOR PRODUCTION OF ASTATINE ISOTOPES 206 TO 211 BY SECONDARY (α, xn) REACTIONS FOLLOWING 150 MeV PROTON BOMBARDMENT OF BISMUTH. M.Lefort, G.Simonoff and X.Tarrago.
C.R. Acad. Sci. (Paris), Vol. 250, No. 1, 106-8 (Jan. 4, 1960). In French.

Fast α-particles produced in the bombardment of bismuth by 150 MeV protons may produce astatine isotopes by secondary reactions of the type (α, xn). Measurements are described of the production of such isotopes of mass numbers 206-211. Since these isotopes have characteristic properties, it was possible to obtain good estimates of (p,α) cross-section in bismuth for α-particles of energy greater than 20 MeV from these measurements. The value of 70 millibarns obtained is too high to be explained by evaporation processes alone.

R.H.Thomas

539.17

7581 A STUDY OF LONG-RANGE PARTICLES FROM POLONIUM SOURCES.
M.Morand, Y.Baudinet-Robinet and L.Winand.
Bull Soc. Roy. Sci. Liege, Vol. 29, No. 1-2, 28-36 (Jan.-Feb., 1960). In French.

Particles from polonium sources of track length above 300μ in nuclear emulsions have been found previously by several authors. It is shown that these are probably due to protons from the reaction $B^{10}(\alpha, p)\, C^{13}$ and $B^{11}\,(\alpha, p)\, C^{14}$, the boron being present as an impurity in the polonium source. Long tracks can also be due to knock-on protons produced by energetic neutrons from the $B^{10}(\alpha, n)\, N^{13}$ and $B^{11}\,(\alpha, n) N^{14}$ reactions. Long tracks observed from ThC' are thought to be due to protons from the $N^{14}(\alpha, p)O^{17}$ reaction, atmospheric nitrogen providing the target nuclei, and the same reaction is postulated as the source of the long range particles from actinium.

A.E.I. Laboratory

539.17

7582 THE SCATTERING OF 38 MeV ALPHA PARTICLES BY C^{12}. I.J.Van Heerden and D.J.Prowse.
Nuclear Phys., Vol. 15, No. 2, 356-62 (Feb. (2), 1960).

The differential cross-sections for the elastic and inelastic scattering of 38 MeV alpha-particles from C^{12} were measured using a photographic technique. Comparison with the work of other authors at slightly different energies indicate that the angular distributions vary rather strongly with beam energy. The variation of the elastic distribution is too great to be explained on the basis of the simple optical model.

539.17

7583 THE SCATTERING OF 38 MeV α-PARTICLES BY C, N, O, F AND Kr NUCLEI. J.Aguilar, W.E.Burcham, J.Catalá, J.B.A.England, J.S.C.McKee and J.Rotblat.
Proc. Roy. Soc. A, Vol. 254, 395-407(Feb. 23, 1960).

Describes observations by a photographic method on the angular distributions of 38 MeV α-particles scattered by light nuclei. Elastically and inelastically scattered particles were distinguished by their range in nuclear emulsion. The observed distributions are compared with the general predictions of the nuclear optical model, of direct interaction theories, and of the inelastic diffraction theory of Blair. Interaction radii are deduced from the angular distributions.

539.17

7584 A NUCLEAR REACTION OF THE (α, α + 3n) TYPE.
W.Riezler.
Nuclear Phys., Vol. 15, No. 1, 143-5 (Feb. [1], 1960). In German.

If caesium is irradiated with alpha-particles, at energies higher than ~55 MeV Cs^{130} is formed. From a calculation of the reaction energies involved it follows that the reaction is (α, α + 3n). It is suggested that the alpha-particle behaves inside the struck nucleus as a cluster, which is emitted again, before all its kinetic energy is distributed to form a compound nucleus.

539.17

7585 F^{19}, Na^{23}, AND $Al^{27}(\alpha,n)$ REACTIONS.
R.M.Williamson, T.Katman and B.S.Burton.
Phys. Rev., Vol. 117, No. 5, 1325-9 (March 1, 1960).

The F^{19}, Na^{23}, and $Al^{27}(\alpha,n)$ yield curves are given from threshold to about 4 MeV. Convenient resonances for alpha-particle energy calibration in these reactions and in the $C^{13}(\alpha,n)$ reaction are pointed out. "Slow–fast" neutron data and γ-ray data for $F^{19}(\alpha,n)$ agree with the proposed 593 and 666 keV Na^{22} levels. The Al^{26m} (228 keV) β-activity was observed in the $Na^{23}(\alpha,n)$ reaction. The neutron resonance absorption technique gave $Q = -1959 \pm 10$ keV for $F^{19}(\alpha,n)$. The $32^0 \pm 3^0$ angle cut-off of $Na^{23}(\alpha,n)$ neutrons at $T_\alpha = 3492 \pm 3$ keV gave a Q value of -2969 ± 4 keV. The threshold for P^{30} β-activity gave $Q \geq -2662 \pm 5$ keV for $Al^{27}(\alpha,n)$.

539.17

7586 ELASTIC SCATTERING OF HEAVY NUCLEI.
J.S.McIntosh, S.C.Park and J.E.Turner.
Phys. Rev., Vol. 117, No. 5, 1284-6 (March 1, 1960).

A programme is presented for determining the differential cross-section for the elastic scattering of heavy nuclei. It utilizes the unitary property of the S matrix and a less drastic L dependence of the absorption than the sharp cutoff model of Blair. It is shown that experimental data can be fitted quite well.

539.17

7587 COULOMB EXCITATION OF ODD-A NUCLEI BY HEAVY IONS. D.G.Alkhazov, A.P.Grinberg, G.M.Gusinskii, K.I.Erokhina and I.Kh.Lemberg.
Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1530-42 (Dec., 1959). In Russian.

High-lying levels in some light nuclei (Al^{27}, Sc^{45}, V^{51}, Nb^{93}), which previously could not be observed because of background when protons or α-particles were used, were excited by using "heavy" ions as bombarding particles. It is established that some of the γ-lines observed in previous investigations, in which chromium was irradiated with protons or α-particles, are not due to Coulomb excitation of the corresponding levels in chromium. By using ions heavier than α-particles it could be verified that the lines associated with nuclear levels excited previously with α-particles (Rb^{87}, Sn^{117}, Sn^{119}) are actually emitted as a result of Coulomb excitation. The partial lifetimes τ(E2) of the excited levels were determined for the electric quadrupole transition. The measured values of τ(E2) lie between 10^{-7} and 10^{-12} sec.

539.17

7588 THE CROSS-SECTION FOR FORMATION OF THE COMPOUND NUCLEUS IN THE INTERACTION OF ATOMIC NUCLEI. V.V.Babikov.

Zh. eksper. teor. Fiz., Vol. 38, No. 1, 274-6 (Jan., 1960). In Russian.

Reactions involving highly charged ions at energies above the Coulomb barrier are considered. On the basis of a semi-classical model, simple expressions are developed for the total cross-section for absorption of the incident ion. Agreement is obtained with experiments on the fission of bismuth by ions of carbon, nitrogen, and oxygen at 60 to 100 MeV. D.W.L.Sprung

539.17

7589 LIGHT POLONIUM ISOTOPES FROM CARBON ION BOMBARDMENTS OF PLATINUM.

H.Atterling and W.Forsling.

Ark. Fys., Vol. 15, Paper 6, 81-8 (1959).

By bombardments of platinum with C^{12} and C^{13} ions in the Stockholm 225 cm cyclotron polonium isotopes of low mass numbers have been produced and their alpha-decay properties studied. One of the alpha activities found has been assigned to Po^{203} with a particle energy of 5.48 MeV and a half-life of 45 ±10 min. For Po^{202} a half-life of 43 min has been obtained. This is considerably shorter than has been reported earlier.

539.17

7590 ELASTIC SCATTERING OF NITROGEN BY CARBON.
M.L.Halbert, C.E.Hunting and A.Zucker.

Phys. Rev., Vol. 117, No. 6, 1545-51 (March 15, 1960).

The differential cross-section for the elastic scattering of nitrogen from thin carbon foils was measured from about 40 to about 140^0 in the centre-of-mass system. The measurements were made at three energies: 27.3 MeV, 23.5 MeV, and 21.5 MeV, mean energy in the 1 MeV thick targets. The angular resolution was about 1 deg. Scattered nitrogen and recoil carbon atoms were counted in coincidence. Positions of the two counters, as prescribed by the kinematics of elastic scattering, served to discriminate against inelastic events and transfer reactions. The differential cross-sections at all three energies exhibit marked structure especially beyond 90^0. An optical model scattering calculation using a Saxon potential with $V = 45$ MeV, $W = 6$ MeV, and $a = 0.65$ fermi was performed. The results of the calculation exhibit fair agreement with the data. The results of the experiment are also compared with the predictions of a sharp cutoff model for elastic scattering and show no agreement with the theory. Analysing the data in terms of a diffraction model the positions of the well-defined minima yield an interaction distance R such that $r_0 = 1.18 \pm 0.02$ in the relation $R = r_0(A_1^{1/3} + A_2^{1/3})$.

539.17

7591 NEUTRON-DEFICIENT POLONIUM ISOTOPES FROM NEON ION BOMBARDMENTS OF WOLFRAM.

H.Atterling, W.Forsling and B.Åström.

Ark. Fys., Vol. 15, Paper 24, 279-88 (1959).

In a series of experiments, cyclotron-accelerated neon ions have been used to bombard different kinds of tungsten targets. The alpha activities of the reaction products have been studied. Several neutron-deficient polonium isotopes were found, one of which was assigned to Po^{196}. The half-life was determined to be 1.8 minutes and the alpha particles emitted had an energy of 6.13 MeV. An activity with a half-life of 0.5 minutes and alpha-particle energy of about 6.23 MeV has also been observed. This activity is probably identical with the one earlier assigned to Po^{195}. Decay data of some neutron-deficient polonium isotopes have been redetermined.

539.17 : 539.16

7592 EXPERIMENTS ON THE PRODUCTION OF A NEW FERMIUM ISOTOPE.

V.P.Perelygin, E.D.Donets and G.N.Flerov.

Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1558-63 (Dec., 1959). In Russian.

The α-active products of interaction between accelerated oxygen O^{16} ions and uranium U^{238} nuclei were studied. Proof was obtained of the existence of a new fermium isotope Fm^{249} which possesses a half-life of about 150 sec and an α-particle energy of (7.9 ± 0.3) MeV. Excitation curves are presented for reactions involving the emission of four and five neutrons: the oxygen-ion energies lie between 84 and 98 MeV. A procedure for identification of transuranium isotopes is described which is based on recording their successive α-decays in nuclear emulsions.

539.1

7593 EXCITATION OF THE NUCLEAR GIANT-DIPOLE RESONANCE BY INELASTIC ELECTRON SCATTERIN

S.Fallieros, R.A.Ferrell and M.K.Pal.

Nuclear Phys., Vol. 15, No. 2, 363-72 (Feb. (2), 1960).

The Goldhaber—Teller model of the giant dipole resonance of a nucleus was cast in the language of the shell-collective model by using the generator coordinate method of Hill, Wheeler and Griffin. The wave-function for the excited state found in this way was used to evaluate explicitly the inelastic electron scattering form factor for excitation of the giant dipole resonance of the nucleus. The form factor is found to be proportional to the elastic form factor multiplied by the momentum transfer. From an estimate of the bremsstrahlung background extracted from Fregeaus's data it is concluded that experimental investigation of the giant dipole resonance by electron scattering is feasible at optimum momentum transfer.

539.1

7594 ON THE POSSIBILITY OF DEMONSTRATING THE PHA COHERENCE IN RESONANCE SCATTERING OF γ-RAY ON NUCLEI. A.Kastler.

C.R. Acad. Sci. (Paris), Vol. 250, No. 3, 509-11 (Jan. 18, 1960). In French.

Discussion of possible experiments to show the coherence of resonant-scattered γ-rays. It is shown that the conditions necessa for a successful experiment are : (i) use of a substance whose struc ture is crystalline; (ii) a 100% isotope, or a sample isotopically enriched to sufficient degree; (iii) possible use of the Mössbauer effe to differentiate between the normal coherent scattering from atomi electrons and the nuclear effect. R.H.Thom

539.1

7595 HIGH ENERGY PHOTO-SPALLATION LEADING TO ^{18}
T.G.Walker and W.T.Morton.

Proc. Phys. Soc., Vol. 75, Pt 1, 4-7 (Jan., 1960).

The cross-sections for the production of F^{18} from F^{19}, Na^{23}, M Al^{27}, Si^{28}, P^{31} and S^{32} by bremsstrahlung with a maximum energy of 240 MeV have been measured. The cross-sections for the producti of F^{18} from F^{19}, Na^{23} and Al^{27} have also been obtained for bremsstr lung with maximum energies of 180 MeV and 120 MeV. The results are compared with other spallation work.

539.1

7596 "BREAKS" IN THE PHOTONEUTRON EXCITATION CURVES OF FLUORINE AND NITROGEN. D.Sadeh.

C. R. Acad. Sci. (Paris), Vol. 250, No. 9, 1632-4 (Feb. 29, 1960). In French.

Determinations of the threshold for the reactions $F^{19}(\gamma,n)F^{18}$ an $N^{14}(\gamma,n)N^{13}$ have been made with good accuracy. Breaks in the excit tion curves, corresponding to levels in the initial nuclei, were found to be in agreement with levels found by other experiments, some ne breaks being found. R.H.Thoma

539.1

7597 STUDY OF SCATTERING AND RESONANT ABSORPTIO OF THE 10.5 MeV LEVEL OF MAGNESIUM 24.

A.Bussière de Nercy.

C. R. Acad. Sci. (Paris), Vol. 250, No. 7, 1252-4 (Feb. 15, 1960). In French.

The data from a previous paper [J. Phys. Radium, Vol. 20, 831 (1959)] on the resonant scattering and absorption of bremstrahlung the 10.5 MeV state in Mg^{24} have been analysed to obtain the characteristics of this level. The angular distribution of scattered radiati indicates that the transition is dipole. The scattering and absorptio cross-sections are used to obtain the nuclear absorption cross-section at resonance and the total level width. L.L.Gre

539.1

7598 FAST PHOTONEUTRONS FROM Be^9, C^{12} AND Al^{27}.
L.A.Kul'chitskii and V.Presperin.

Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1524-9 (Dec., 1959). In Russian.

The authors studied the angular distributions of photoneutrons with energies above 10 MeV emitted by Be^9, C^{12} and Al^{27} targets irradiated with 88 MeV peak energy bremsstrahlung. The energy spectrum of photoneutrons emitted at an angle of 75^0 from C^{12} was also investigated and the data thus obtained were used to compare the photoneutron and photoproton yields in the same energy intervals. The angular distribution results are compared with the quasideuteron model and direct resonance nuclear photoeffect. Qualitative agreement with the quasideuteron model has been obtained.

539.17

7599 $(\gamma,{}^{np}_{d})$ REACTIONS IN S^{32}, Ca^{40}, Ge^{70}.

F.Ferrero, S.Ferroni, R.Malvano, S.Menardi and E.Silva.
Nuclear Phys., Vol. 15, No. 3, 436-51 (March (1), 1960).

A detailed study, up to 31 MeV, of the (γ,np) and (γ,d) reactions in S^{32}, Ca^{40} and Ge^{70} was carried out, together with the study of the other processes: (γ,n), (γ,Tn) $(\gamma,Tn)_{E_n} \geq 5.5$ MeV. A rather flat cross-section is found for the $(\gamma,{}^{np}_{d})$ reaction, peaking presumably above 31 MeV. In the case of S and Ca it is found besides that the neutron spectrum associated with the above reaction is much more energetic than could be explained on the basis of a simple evaporation process. A discussion is given of the possible explanation of the above experimental evidence on the basis of some direct photonuclear process.

539.17

7600 NUCLEAR REACTION CROSS-SECTION THEORY.

R.G.Moore, Jr.
Rev. mod. Phys., Vol. 32, No. 1, 101-16 (Jan., 1960).

The branching ratio for gamma-ray emission is given by the ratio of radiation width to total width. The radiative-capture cross-section in the resonance region is obtained by multiplying this branching ratio by the resonance compound-nucleus cross-section. The result is the well-known Breit—Wigner equation, which is used to demonstrate that the capture-cross section in the thermal region is inversely proportional to the neutron velocity. With increasing energy the resonances gradually become wider until they form a continuum. The capture cross-section in this region was obtained in a general form and reduced by means of simplifying assumptions.

539.17

7601 INELASTIC SCATTERING OF NEUTRONS AND SURFACE DIRECT PROCESSES.

H.Ui.
Progr. theor. Phys., Vol. 18, No. 2, 163-82 (Aug., 1957).

In the case where the residual nucleus is left in a definite low-lying excited state, the surface direct processes (through single particle excitation and through the same sort of many particle excitations) are formulated in a similar manner to the deuteron-stripping reaction. The distorted wave method is used and its validity for these processes is discussed in detail. The cross-sections obtained are compared with those of another surface direct process accompanied by collective excitation, and with those of the compound nucleus formation process. It is shown that for intermediate and heavy nuclei (i) the collective excitation is much larger than the single particle excitation and (ii) the compound nucleus is more important than the surface direct process in the low energy region in which there are few open channels. In the higher energy region where many channels are open, the latter is much larger than the former.

539.17

7602 ON THE METHOD OF MEASUREMENT OF THE EFFECTIVE CROSS-SECTIONS FOR INELASTIC SCATTERING OF FAST NEUTRONS.

J.Vervier.
J. Phys. Radium, Vol. 18, No. 10, 604 (Oct., 1957). In French.

A correction factor for the measured inelastic cross-sections is calculated to take into account the asymmetry in the distribution about 90° of γ-rays from the de-excitation of the target nucleus.

S.J.St-Lorant

539.17 : 539.14

NUCLEAR MULTIPLETS IN LIGHT ODD-ODD NUCLEI AND THEIR MANIFESTATION IN GAMMA-TRANSITIONS FOLLOWING THERMAL NEUTRON CAPTURE. See Abstr. 7483

539.17

7603 INELASTIC COLLISION CROSS-SECTIONS OF VARIOUS ELEMENTS FOR 14.5 MeV NEUTRONS.

N.N.Flerov and V.M.Talyzin.
J. nuclear Energy, Vol. 4, No. 4, 529-32 (April, 1957). English translation of article in: Atomnaya Energiya, Vol. 1, No. 4, 155 (1956).

Reports measurements on 24 elements, Be to Bi, with errors between 1 and 6%. The inelastic cross-section, σ_{in}, is well represented by the relation

$$(\sigma_{in}/\pi)^{1/2} = (1.2\ A^{1/3} + 2.1) \times 10^{-13}\text{cm},$$

where A is the atomic weight. The total cross-section cannot be given by a straight line; therefore the total elastic cross-section for 14 MeV neutrons is not linear in $A^{1/3}$.

E.J.Burge

539.17 : 539.16

NEUTRON CROSS-SECTION OF $Am^{241}(n,\gamma)Am^{242m}$.
See Abstr. 7508.

539.17

7604 SUCCESSIVE NEUTRON CAPTURE IN ANTIMONY.

A.N.Murin, V.D Nefedov, D.K.Popov and V.I.Baranovskii.
J. nuclear Energy, Vol. 7, No. 3-4, 265-6 (Sept., 1958). English translation of article in: Atomnaya Energiya, Vol. 2, 553 (1957).

If antimony is irradiated by a neutron beam of sufficient intensity, double neutron capture can take place according to the following scheme:

$$Sb^{123} \xrightarrow{(n,\gamma)} Sb^{124} \xrightarrow[\substack{T = 60\\ \text{days}}]{(n,\gamma)} Sb^{125} \quad (T = 2.7 \text{ years})$$

Sb^{125} then changes by β -decay into Te^{125*} (T = 58 days), the latter nucleus being a high isomeric state of stable Te^{125}. Te^{125*} was isolated from antimony targets which had been stored for about a year after neutron irradiation to allow sufficient accumulation of the tellurium. Te^{125} came down with the stable Te and metallic tellurium was separated by treatment with stannic chloride. An appreciable Te^{125*} activity was observed in the metal, as indicated by the half-life of 57 ± 4 days, deduced from the amount accumulated in the antimony.

539.17

7605 GAMMA RAYS FROM NEUTRON INELASTIC SCATTERING IN B^{10}, F^{19}, AND Fe^{56}.

R.B.Day and M.Walt.
Phys. Rev., Vol. 117, No. 5, 1330-3 (March 1, 1960).

The cross-section for excitation of the 0.72 MeV gamma ray in the $B^{10}(n,n'\gamma)B^{10}$ reaction was measured for neutron bombarding energies from threshold to 5.2 MeV. Resonances were observed at 1.93, 3.31, 4.1, and 4.73 MeV, with evidence of a broad resonance at 2.6 MeV. The angular distributions of the 0.110 and 0.197 MeV gamma rays in the $F^{19}(n,n'\gamma)F^{19}$ reaction and the 0.847 MeV gamma ray in the $Fe^{56}(n,n'\gamma)Fe^{56}$ reaction were also measured at a neutron energy of 2.56 MeV. The first of these was isotropic, as would be expected for the decay of a spin-½ level; the last two showed anisotropies but were symmetrical about 90°. The angular distribution of the Fe^{56} gamma ray agrees very well in both shape and absolute magnitude with calculations based on the statistical model. Since this model predicts angular distributions for Fe^{56} that have a strong dependence on the spin assumed for the excited state, it appears that such angular distribution measurements may be a useful technique in nuclear spectroscopy.

539.17

7606 ENERGY AND ANGULAR DEPENDENCE OF THE LEFT—RIGHT ASYMMETRY OF D—D NEUTRONS SCATTERED BY CARBON.

P.S.Dubbeldam, C.C.Jonker and H.J.Boersma.
Nuclear Phys., Vol. 15, No. 3, 452-63 (March [1], 1960).

The left—right asymmetry in the intensity of neutrons from the D—D reaction, scattered by carbon, was measured for deuteron energies between 300 and 500 eV, at two angles $\theta_{1lab} = 50^0$ and $22^0\ 30'$, with a gold "drive-in" target. The polarization vector was turned by the magnetic field of a solenoid, and the detectors remained in a fixed position. From the comparison of the computed, energy average of the effect with the experimental values it follows that the analysing properties of C^{12} derived from the phase analysis of Meier et al.(Abstr. 6469 of 1955) give a much better agreement than those according to Willis et al. (Abstr. 8345 of 1958). The experiments could not decide upon the possible existence of a $\sin 4\theta_1$ dependence of the differential polarization of the D—D neutrons. From the energy dependence of the differential polarization taken from other authors it follows that, within the limits of the description of the D—D reaction by Beiduk, Pruett and Konopinski (Abstr. 5266 of 1950), indeed other non-central forces besides the tensor force are present in the nucleon—nucleon interaction.

539.17

7607 ANGULAR DISTRIBUTION OF 2.35 MeV NEUTRONS SCATTERED ELASTICALLY AND INELASTICALLY BY THE NUCLEI OF CHROMIUM, IRON AND LEAD.

O.A.Sal'nikov.
J. nuclear Energy, Vol. 8, No. 1-3, 119-26 (Nov., 1958). English

translation of article in Atomnaya Energiya, Vol. 3, No. 8, 106 (1957).

The spectra of neutrons scattered by the nuclei of chromium, iron and lead, have been measured for an incident neutron energy of 2.34 MeV. Differential cross-sections were measured for elastic and inelastic scattering in the angular range 30°–135°. The incident neutrons were obtained from the $D(d,n)He^3$ reaction using a deuteron energy of 1 MeV and an angle of emission for the neutrons of 110°. Nuclear photographic emulsions were used as the detector-spectrometer and for monitoring the direct flux. The scattering media were in the form of 2.8 cm diameter spheres. In calculating elastic and inelastic scattering cross-sections corrections were applied for the attenuation of the direct flux in the scattering medium due to self-screening and for multiple scattering. The angular distribution of neutrons inelastically scattered by chromium and iron, and also by lead in the case of excitation of the 0.53 MeV level, was found to be isotropic within the limits of experimental error. Inelastic scattering by lead in the case of excitation of the 0.805 and 0.890 MeV levels cannot be considered as isotropic.

539.17

7608 THE NEUTRON TOTAL CROSS-SECTION OF KRYPTON.
S.J.Cocking.

J. nuclear Energy, Vol. 6, No. 1-2, 113 (1957).

The fast-neutron chopper on BEPO has been used to measure the total cross-section of atmospheric krypton between neutron energies of 0.01 eV to 100 keV. Gaseous samples having 0.286×10^{22} and 1.75 ± 10^{22} atoms/cm² in aluminium alloy cylinders were used. The cross-sections in the thermal region were consistent with a constant scattering plus $1/\sqrt{E}$ absorption law. The derived scattering cross-section was 7.5 ± 0.6 barns and the absorption cross-section (at 2200 m/sec) 30.6 ± 1.8 barns.

539.17

7609 SCATTERING OF 14.6 MeV NEUTRONS BY Mg, Ca, Cd, Ta AND Bi.
W.G.Cross and R.G.Jarvis.

Nuclear Phys., Vol. 15, No. 1, 155-65 (Feb. [1], 1960).

Differential cross-sections for 14.6 MeV neutrons scattered elastically from Mg, Ca, Cd and Bi were measured at 25 angles between 8° and 130° and from Ta at angles out to 80°. A neutron beam was defined by counting only neutrons in delayed coincidence with a collimated beam of alpha-particles from the $T(d,n)He^4$ reaction. The neutron detector bias was set to reject neutrons below 10.5 MeV. The results are corrected for angular resolution (±3°) and for absorption and multiple scattering in the thin (0.05 to 0.1 MFP) cylindrical scatterer. The results were compared with optical model calculations made by other workers.

539.17

7610 (n,He^3) REACTIONS OF MEDIUM WEIGHT NUCLEI INDUCED BY 14.8 MeV NEUTRONS.
I.Kumabe, A.D.Poularikas, I.L.Preiss, D.G.Gardner and R.W.Fink.

Phys. Rev., Vol. 117, No. 6, 1568-9 (March 15, 1960).

Activation of the following pure monoisotopic elements with 14.8 MeV neutrons gives rise to (n,He^3) reactions as observed by measuring the radioactive products having the following measured half-lives and formation cross-sections: $Mn^{55}(n,He^3)V^{53}$, 2 ± 0.3 min, 2-6 mb; $Co^{59}(n,He^3)Mn^{57}$, 1.75 ± 0.2 min, 1-3 mb; $As^{75}(n,He^3)Ga^{73}$, 5.1 ± 0.3 hours, 3-7 mb; and $Rh^{103}(n,He^3)Tc^{101}$, 15 ± 3 min, 1.5-3.5 mb. A qualitative discussion is presented concerning the possible mechanisms for these reactions.

539.17

7611 THE SLOW NEUTRON TOTAL CROSS-SECTION OF ^{143}Nd.
H.J.Hay.

J. nuclear Energy, Vol. 7, No. 3-4, 199-204 (Sept., 1958).

Crystal spectrometers covering the energy range 0.01-10 eV have been used to measure the transmission of neodymium oxide enriched in the isotope Nd^{143}. Analysis of the energy dependence of the Nd^{143} total cross-section gives the 2200 m/sec cross-sections as 335 ± 20 barns for absorption and 75 ± 7 barns for scattering, and the parameters of a negative energy resonance are $E_0 = -6 \pm 1$ eV, $\Gamma_\gamma = 86 \pm 15$ mV, $\Gamma_n{}^0 = 68 \pm 15$ mV.

539.17

7612 NEW ISOTOPES OF COBALT; ACTIVITY CROSS-SECTIONS OF NICKEL, COBALT, AND ZINC FOR 14.8 MeV NEUTRONS.
I.L.Preiss and R.W.Fink.

Nuclear Phys., Vol. 15, No. 2, 326-36 (Feb. (2), 1960).

Absolute neutron activation cross-sections at 14.8 MeV were measured for the five stable nickel isotopes ($Ni^{58,60,61,62,64}$) for Co^{59} and for $Zn^{64,66,68}$, based on comparison with the $Cu^{63}(n,2n)Cu^{62}$ reaction (556 mb), the $Cu^{65}(n,2n)Cu^{64}$ reaction (1000 mb), and the $Al^{27}(n,\alpha)Na^{24}$ reaction (115 mb). During the course of this investigation, three new cobalt activities have been identified as Co^{63}, 1.40 ± 0.05 hr, and Co^{64} isomers: Co^{64m}, 2.0 ± 0.2 min, and Co^{64g}, 7.8 ± 0.2 min. The reactions studied, measured half-lives and activation cross-sections are listed. Comparison is made between the experimental cross-sections and the continuum model of the compound nucleus described by Blatt and Weisskopf. A discussion is presented concerning the possible reasons for the deviation of the experimental values from those calculated from theoretical considerations.

539.17

7613 THE $^{58}Ni(n,p)^{58}Co$, $^{58}Ni(n,2n)^{57}Ni$, AND $^{58}Ni(n,np)^{57}Co$ CROSS SECTIONS AT 14.1 MeV.
K.H.Purser and E.W.Titterton.

Austral. J. Phys., Vol. 12, No. 1, 103-5 (March, 1959).

The cross-sections for these reactions, for 14.1 MeV neutrons produced by the $H^3(d,n)He^4$ reaction, were measured as $(560 \pm 110) \times 10^{-27}$ cm², $(38 \pm 8) \times 10^{-27}$ cm² and $160 \pm 40 \times 10^{-27}$ cm², respectively. The yield from the first reaction was obtained by counting in calibrated geometry, the positron annihilation quanta from Co^{58} and using a previously published value of 5.89 for the K/β^+ branching ratio. The yield of the second reaction was similarly obtained from the 36 hr half-life positron decay of Ni^{57} to Co^{57}, giving a cross-section value in good agreement with a previously published value. The ratio of the yield of the third reaction to the second was obtaine by comparing the ratios of the amount of Co^{57} in the sample just afte irradiation with that produced in the sample from the 36 hr half-life decay of Ni^{57} over a period of one week. From the ratio $\sigma(n,np)/\sigma(n,2n) = 4.5 \pm 0.9$ obtained in the present work it appears that proton emission from the excited nucleus is favoured over neutron emission.

A.E.I. Research Laboratory

539.17

7614 THE THERMAL NEUTRON ABSORPTION CROSS-SECTION AND RESONANCE ABSORPTION INTEGRAL OF ^{240}Pu.
P.A.Krupchinsky.

J. nuclear Energy, Vol. 6, No. 1-2, 155-62 (1957). English translation of article in: Atomnaya Energiya, Vol. 2, No. 3, 240 (1957).

The thermal neutron absorption cross-section and the resonanc absorption integral of Pu^{240} have been measured by the pile-oscillato method. Observations were made both within the lattice and in the central thermal column of the Academy of Sciences heavy-water reactor. Three specimens were used, having different concentrations of the isotopes Pu^{239}, Pu^{240} and Pu^{241}; the pile power fluctuations resulting from periodic oscillation of the samples were traced on the chart of a recording potentiometer. A range of specimen sizes was employed so that the effects of self-screening could be eliminated by extrapolation. The neutron energy spectra in the lattice and in the thermal well were characterized by the cadmium ratio for indiu Pu^{240} cross-sections found were: in the thermal well, 560 ± 35 barn in the lattice, 1010 ± 120 barns. The thermal neutron absorption cross-section of Pu^{240} came to $\sigma^T = 460 \pm 45$ barns, and the resonance absorption integral to $\Sigma = 10\,000 \pm 2800$ barns. The former coincides with the figure which would be calculated for the contribution of the resonance level at $E_0 \sim 1$ eV, indicating that Pu^{240} can have no strong level between 1 eV and some distance into the negativ energy region. It would also follow that Pu^{240} has 1/v absorption at thermal energies.

539.17

7615 THE SLOW-NEUTRON RESONANCE BEHAVIOUR OF PLUTONIUM ISOTOPES.
P.A.Egelstaff, D.B.Gayther and K.P.Nicholson.

J. nuclear Energy, Vol. 6, No. 4, 303-21 (May, 1958).

The neutron total cross-sections of several plutonium samples have been measured from 0.02 eV to 51 keV, using the Harwell fast chopper. The samples contained various abundances of Pu^{239}, Pu^{240}, Pu^{241} and Pu^{242}, making it possible in most cases to assign an observed resonance level to its particular isotope. The maximum resolution of the spectrometer was 0.11 μsec/m, and at energies below about 40 eV resonance parameters were obtained for the identified levels using the area method of analysis. The distributions of neutron widths and level spacings in Pu^{239} are compared with the theoretical predictions of Porter and Thomas (1956) and Wigner (1956). A value of $(1.3 \pm 0.2) \times 10^{-4}$ for the ratio of average reduce neutron width to average level spacing, $\Gamma_n^0/\bar{D}$, is deduced from the observed average cross-section of Pu^{239} above 500 eV. The value o

$\Gamma_n^0/\bar{D}$ obtained from the separate parameters measured at low energies is $(1.0 \pm 0.2) \times 10^{-4}$. The fluctuations in the observed cross-section are analysed in terms of theoretical distributions in neutron widths and level spacings. These data are compared with those of other groups where available.

539.17

7616 MEASUREMENTS OF THE EFFECTIVE THERMAL NEUTRON CROSS-SECTION AND THE RESONANCE ABSORPTION INTEGRAL OF ^{232}Th.

G.G.Myasishcheva, M.P.Anikina, L.L.Gol'din and B.V.Ershler.

J. nuclear Energy, Vol. 5, No. 2, 230-5 (1957). English translation of article in Atomnaya Energiya, Vol. 2, 22 (1957).

The effective thermal neutron cross-section of thorium (σ_{th} = 7.31 ± 0.10 barn) and the resonance integral for thorium have been measured in a heavy-water reactor by an activation method. Gold, indium, and uranium were used as standards. Improved values for the effective thermal neutron cross-section of indium (σ_{th} = 162 ± 10 barn) and for the resonance integral of indium (RI = 2340 ± 200 barn) were determined.

539.17

7617 THE RATIO OF THE (n,γ) TO (n,2n) CROSS-SECTION FOR THORIUM-232 BOMBARDED WITH FISSION NEUTRONS. R.A.Hasse, P.Kafalas and R.R.Heinrich.

J. nuclear Energy, Vol. 7, No. 3-4, 205-9 (Sept., 1958).

Thorium-232 was exposed to an unmoderated neutron flux produced by uranium-235 fission. The ratio of the integrated cross-sections for the (n,γ) and (n,2n) reactions was determined to be 11.3 ± 0.3.

539.17

7618 THE (n,2n) CROSS-SECTION OF ^{232}Th FOR FISSION NEUTRONS. J.A.Phillips.

J. nuclear Energy, Vol. 7, No. 3-4, 215-19 (Sept., 1958).

The mean value of the (n,2n) cross-section of Th^{232} for neutrons from U^{235} fission has been determined. Decigramme quantities of thorium nitrate were irradiated inside a hollow fuel element in the BEPO reactor. The Th^{233} formed was allowed to decay into Pa^{233}, which was then chemically separated from the thorium together with the fission products. The quantity of Th^{231} produced was found by measuring the intensity of the 25.6 keV gamma-ray coming from the decay of this isotope using a krypton-filled proportional counter. A U^{235} fission foil was used for the intensity calibration of the counter. Ammonium shlphate was used as a flux monitor, the activity of the P^{32} from the threshold reaction $S^{32}(n,p)P^{32}$ giving the flux. A value of 12.4 ± 0.6 millibarns was obtained for the mean value of the (n,2n) cross-section in a fission spectrum.

539.17

7619 RESONANCE ABSORPTION IN HOMOGENEOUS MIXTURES. K.T.Spinney.

J. nuclear Energy, Vol. 6, No. 1-2, 53-65 (1957).

The problem of calculating resonance absorption probabilities in homogeneous mixtures of uranium and hydrogen is discussed. Quantitative results are presented of the absorption in individual uranium resonances as computed by various approximate methods and these are compared with numerical solutions of the exact expression. The calculations, which are for a 1 : 1 atomic ratio, make use of experimental data now available for the first eighteen resonances in uranium and include the effects of Doppler-broadened cross-sections. A new "modified" narrow resonance approximation is derived which is shown to give considerably greater accuracy over most of the energy range. Results are also included for non-Doppler-broadened cross-sections and for mixtures diluted with more hydrogen.

539.17 : 539.14

SLOW-NEUTRON FISSION CROSS-SECTIONS OF U^{235} AND Pu^{239}. See Abstr. 7480

539.17

7620 THE THERMAL NEUTRON CAPTURE CROSS-SECTION AND THE RESONANCE-CAPTURE INTEGRAL OF ^{236}U.

M.J.Cabell, T.A.Eastwood and P.J.Campion.

J. nuclear Energy, Vol. 7, No. 1-2, 81-7 (Aug., 1958).

The thermal neutron capture cross-section and the resonance capture integral of U^{236} have been determined by an activation method. Assuming 36.5 barns for the thermal neutron capture cross-section of Co^{59}, a value of σ_{2200} = 5.5 ± 0.3 barns has been obtained for U^{236}. The resonance-capture integral (from 0.5 eV to ∞) was found to be 257 ± 22 barns relative to 48.6 barns for Co^{59}. The half-life of U^{237} has been determined as 16.04 ± 0.05 hours.

539.17

7621 ENERGY SPECTRA OF NEUTRONS INELASTICALLY SCATTERED BY U^{238}. N.I.Fetisov.

J. nuclear Energy, Vol. 8, No. 1-3, 156-9 (Nov., 1958). English translation of article in: Atomnaya Energiya, Vol. 3, No. 9, 211 (1957).

539.17

7622 FAST NEUTRON CAPTURE IN ^{238}U AND ^{232}Th.

R.C.Hanna and B.Rose.

J. nuclear Energy, Vol. 8, No. 4, 197-205 (Jan., 1959).

The cross-sections for neutron capture in U^{238} and Th^{232} have been measured by an activation method for mono-kinetic incident neutrons in the energy range 30-1000 keV.

539.17

7623 THE RESONANCE ABSORPTION INTEGRAL OF ^{238}U.

C.Erginsoy.

J. nuclear Energy, Vol. 8, No. 4, 215-23 (Jan., 1959).

The resonance absorption integral of infinitely diluted U^{238} is calculated between the first resolved level (6.7 eV) and 1 MeV. The energy-independent parameters Γ_n^0/D and Γ_γ/Γ_n^0 of the average absorption cross-section are determined from the region of resolved resonances and the nuclear model theories. The effect of $l > 0$ neutrons is shown to be small but significant. The total value of 277 ± 10 per cent barns is in good agreement with experiment.

539.17

7624 INELASTIC CROSS-SECTIONS FOR FISSION-SPECTRUM NEUTRONS. I. H.A.Bethe, J.R.Beyster and R.E.Carter.

J. nuclear Energy, Vol. 3, No. 3, 207-23 (Oct., 1956).

The general problem of determining inelastic cross-sections for sphere transmission measurements is considered. Experimental problems encountered in this type of investigation are discussed. Analytical methods of correcting for multiple scattering and other important effects in spherical shells are presented. These methods are applied to the determination of average inelastic cross-sections of many materials for fission-spectrum neutrons. Experimental work with U^{238}, Np^{237} and $Al^{27}(n,p)Mg^{27}$ threshold detectors is evaluated.

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7625 INELASTIC CROSS-SECTIONS FOR FISSION-SPECTRUM NEUTRONS. II. H.A.Bethe, J.R.Beyster and R.E.Carter.

J. nuclear Energy, Vol. 3, No. 4, 273-300 (Nov., 1956).

For Pt I see preceding abstract. The theory of anisotropic scattering is outlined and an analytical justification of the transport approximation is given. Escape probabilities are determined after the first, second and third or later transport collisions. The importance of collision distribution and the escape probability including explicitly the elastic scattering angular distribution is discussed. Corrections for various factors are considered in detail.

539.17

7626 INELASTIC CROSS-SECTIONS FOR FISSION-SPECTRUM NEUTRONS. III. H.A.Bethe, J.R.Beyster and R.E.Carter.

J. nuclear Energy, Vol. 4, No. 1, 3-25 (Jan., 1957).

For Pt II see preceding abstract. A description of sphere transmission measurements for which Np^{237}, U^{238} and Al^{27} threshold detectors were used. The effective thresholds of these detectors are discussed and the average inelastic cross-sections measured in the experiments defined. Several mathematical relationships appropriate to group theory are discussed in which neutrons are assigned to a number of discrete energy groups. Reciprocity theory for spherical shell experiments and the theory of possible experimental methods for inelastic transfer cross-section measurements are included. The experimental arrangements of the scattering experiments are described using fission neutrons produced by a U^{235} converter plate irradiated by thermal neutrons from the Los Alamos water boiler reactor. Small fission chambers or spirals of Al foil were used as detectors and supported at the centre of the hollow spheres used in the experiments. Experimental corrections for fast neutrons coming direct from the reactor, room scattering, scattering from supports, γ-ray effects, counter size and counter angular asymmetry are considered. R.D.Smith

539.17

7627 INELASTIC CROSS-SECTIONS FOR FISSION-SPECTRUM NEUTRONS. IV. H.A.Bethe, J.R.Beyster and R.E.Carter.

J. nuclear Energy, Vol. 4, No. 2, 147-63 (Feb., 1957).

For Pt III see preceding abstract. Describes the results of shell transmission measurements with threshold detectors making use of fission of Np^{237} and U^{238}, and the $Al^{27}(n,p)Mg^{27}$ reaction (thresholds at 0.7, 1.4 and 5 MeV respectively). Cross-sections for removing fission-spectrum neutrons non-elastically from above the effective thresholds are given for the 15 elements studied, and a two-group analysis used to determine cross-sections for scattering between groups. Cross-sections are found to increase markedly as the threshold is increased. Above the aluminium threshold the cross-section is very nearly the geometric cross-section of the nucleus, which limits the transparency allowable in a "cloudy crystal ball" model. Magic number nuclei have smaller cross-sections, particularly at lower energies. A.E.I. Research Laboratory

539.17

7628 INVESTIGATION OF γ-RAYS EMITTED WHEN THERMAL NEUTRONS ARE CAPTURED BY VANADIUM, MANGANESE, COBALT AND ALUMINIUM NUCLEI.

L.V.Groshev, A.M.Demidov, V.N.Lutsenko and V.I.Pelekhov.
J. nuclear Energy, Vol. 8, No. 1-3, 127-47 (Nov., 1958). English translation of article in Atomnaya Energiya, Vol. 3, No. 9, 187 (1957).

A magnetic spectrometer analysing Compton electrons has been used to measure the energies and intensities of γ-rays emitted by the nuclei formed when thermal neutrons are captured by vanadium, manganese, cobalt and aluminium. The γ-ray spectra were studied in the energy range 0.25 - 11.5 MeV for vanadium, and 0.25 - 8 MeV for manganese, cobalt and aluminium. Transition schemes have been worked out for the nuclei V^{52}, Mn^{56}, Co^{60} and Al^{28}. The γ-rays emitted during the radioactive decay of Mn^{56} were investigated.

539.17

7629 NUCLEAR SHELL EFFECTS IN μ^- CAPTURE.

G.H.Burkhardt and C.A.Caine.
Phys. Rev., Vol. 117, No. 5, 1375-8 (March 1, 1960).

The total capture rate for μ^- mesons in complex nuclei can give some information on the spin-dependence of the weak interaction, by utilizing the variation from one nucleus to another of the spin-dependence of the nuclear transition. The calculation was carried out for N^{14}, O^{16}, and F^{19}, using shell-model wave functions which included configurational mixing in the unfilled shell. The result is not sufficiently spin sensitive to determine the Fermi and Gamow–Teller couplings separately at this stage, but it is in accord with the universal V–A hypothesis, if a conserved vector current pion–lepton interaction is included.

539.17

7630 PRODUCTION OF MULTICHARGED PARTICLES ON PHOTOGRAPHIC EMULSION NUCLEI BY 280 MeV π^+-MESONS.

N.S.Ivanova, V.I.Ostroumov and Yu.V.Pavlov.
Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1604-12 (Dec., 1959). In Russian.

Production of fragments in nuclear disintegrations induced by 280 MeV π^+-mesons was studied by the aid of photographic emulsions. The angular, charge and energy distributions of the emitted fragments were measured. An analysis of the experimental data and comparison with the results of theoretical calculations show that the particles responsible for formation of the fragments are protons, produced in the absorption of π^+-mesons by quasi-deuteron pairs, and recoil nucleons, produced in scattering of π-mesons on separate nucleons of the nucleus. Some suggestions regarding the mechanism of formation of such fragments are made on the basis of an analysis of the energy spectra of fragments produced by particles of various energies.

539.17

7631 ASYMMETRIC FISSION OF HEAVY NUCLEI.

S.G.Ryzhanov.
Bul. Inst. Politeh. Iasi, Vol. 4 (8) No. 3-4, 113-18 (1958). In Russian.

By generalization of the quantum-mechanical formulae for the alpha-decay, a formula is obtained for the probability of asymmetric fission of a heavy nucleus into two fragments with the given atomic and mass numbers. Distribution of the fragment yields and dependence of the period of spontaneous fission on the parameter of stability were also calculated. P.Roman

539.17

7632 STATISTICAL THEORY OF THE ANGULAR DISTRIBUTION OF FISSION FRAGMENTS.

V.M.Strutinsky.
J. nuclear Energy, Vol. 7, No. 3-4, 239-46 (Sept., 1958). English translation of article in: Atomnaya Energiya, Vol. 2, 508 (1957).

The angular distribution of fragments is considered in the ca where fission takes place at an excitation energy high enough for t momentum to be distributed among a large number of nucleons, so that the statistical theory of the nucleus applies. The distribution the states of the "transitional" nucleus over K, the projection of t angular momentum of the compound nucleus along the fission axis is calculated. The most probable state is that with K = 0, which i the case of neutron-induced fission leads to maxima at 0° and 180° in the angular distribution of the fragments. These results are co pared with experiment, and the moment of inertia of the "transitio nucleus about the symmetry axis (the direction of fission) determi thereby. Consideration is also given to the angular distributions r sulting from fission induced by charged particles and γ-quanta.

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7633 FISSION OF HEAVY NUCLEI BY HIGH-ENERGY PARTICLES.

A.K.Lavrukhina and L.D.Krasavina.
J. nuclear Energy, Vol. 5, No. 2, 236-46 (1957). English translation of article in Atomnaya Energiya, Vol. 2, 27 (1957).

The results of radio-chemical investigations of the fission of uranium, thorium, and bismuth nuclei by 480 MeV protons have be analysed. An interpolation method was used to obtain a full descr tion of the fission products. It was observed that there was a predominant formation (58-64%) of isotopes having a neutron excess, and it is shown that isotopes of maximum yield are essentially amongst these nuclei. Symmetrical fission is most probable in th case of bismuth. For uranium and thorium the fission cross-section is 55 and 60% respectively of the geometrical cross-section, for bismuth it is 5%. The charge distribution of the fissic fragments produced by high-energy protons is independent of the mass number of the fission fragments and the atomic number of th fissioning nuclei. The results support a mixed barrier-emissive mechanism for the fission of uranium and thorium nuclei.

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7634 THE YIELDS OF RARE-EARTH ISOTOPES FROM THE FISSION OF ^{239}Pu BY PILE NEUTRONS.

L.M.Krizhanskii, Ya.Malyi, A.N.Murin and B.K.Preobrazhenkskii.
J. nuclear Energy, Vol. 6, No. 3, 260-2 (1958). English translation of article in: Atomnaya Energiya, Vol. 2, 276 (1957).

The authors have determined by mass spectrometry the yields of rare-earth isotopes from the fission of Pu^{239}. They did not sepa ate the plutonium from the fission products but carried out a direc mass-spectrometric analysis of the sediments of the plutonium nitrate solutions and its fission products, changing the temperatur from element to element, of the source filament.

539.

7635 MEASUREMENTS ON THE EFFECTIVE NUMBER OF SECONDARY NEUTRONS EMITTED BY ^{239}Pu OVER T PRIMARY NEUTRON ENERGY RANGE 7-30 eV.

I.V.Kirpichnikov, V.V.Okorokov and S.I.Sukhoruchkin.
J. nuclear Energy, Vol. 6, No. 1-2, 163-8 (1957). English translation of article in: Atomnaya Energiya, Vol. 2, No. 3, 247 (1957).

η has been measured for Pu^{239} between incident neutron energ of 7 and 30 eV by a direct count of the fast neutrons emitted under slow neutron bombardment. The resolving power of the neutron velocity selector has been increased, making it possible to measu Γ_f/Γ_γ for certain resonances. ν was taken to be constant througho the energy range studied. Fission widths are given for ten levels of Pu^{239}. They differ markedly among themselves, and can be divi into groups.

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7636 MEASUREMENTS OF THE ENERGY DEPENDENCE O THE FISSION NEUTRON YIELD PER NEUTRON ABSORBED IN ^{239}Pu AND ^{235}U IN THE RANGE 0.006-0.36 eV.

H.M.Skarsgard and C.J.Kenward.
J. nuclear Energy, Vol. 6, No. 3, 212-20 (1958).

The energy dependence of η, the fission neutron yield per neutron absorbed, has been measured for Pu^{239} over the energy range 0.0070-0.36 eV and for U^{235} over the range 0.0060-0.050 eV using a crystal spectrometer. For energies less than 0.050 eV a mechanical neutron-velocity selector was used in conjunction with the crystal spectrometer to eliminate higher order neutrons from the diffracted beam. For Pu^{239}, at 0.3 eV, η is found to be 78.5 pe cent of its value at 0.0253 eV. A theoretical expression for η, bas on single level parameters deduced from the published total cross section values, is fitted to the measured variation and gives a valu for the ratio of radiative capture to fission in the 0.297 eV resona of 0.80 ± 0.05. The temperature coefficient of the effective value averaged over a Maxwellian flux distribution is −0.027 per cent per deg C for temperatures in the vicinity of 20°C. Within experimental errors, η for U^{235} appears constant from 0.006 to 0.050 eV.

539.17

7637 FISSION CROSS SECTION OF PLUTONIUM-242.

D.K.Butler.

Phys. Rev., Vol. 117, No. 5, 1305-6 (March 1, 1960).

The cross-section for neutron-induced fission of Pu^{242} was measured between 0.1 and 1.7 MeV. The measurement was made by determining the ratio of the Pu^{242} fission cross-section to that of U^{235} using a back-to-back gas scintillation counter.

539.17

7638 INTERPRETATION OF DELAYED NEUTRON PHENOMENA.

G.R.Keepin.

J. nuclear Energy, Vol. 7, No. 1-2, 13-34 (Aug., 1958).

The Bohr-Wheeler mechanism of delayed neutron emission has been used, together with recent fission mass- and charge-distribution data, to interpret the observed characteristics of delayed neutrons from fission. This interpretation accounts satisfactorily for recently measured periods and relative abundances of the delayed neutrons from six fissionable nuclides U^{233}, U^{235}, U^{238}, Pu^{239}, Pu^{240} and Th^{232}. A set of selection criteria are developed which lead to prediction of the "most probable" main precursors as well as possible contributors for each delayed neutron group. Assuming the most probable set of delayed neutron precursors, total delayed neutron yields have been calculated for each of the six fissionable nuclides studied. These calculated yields are in agreement with experiment, thus providing a reasonable explanation of the striking variation in observed total delayed neutron yields, which increase by an order of magnitude from Pu^{239} to Th^{232} fission. Throughout the analysis, special attention is given to the dominant role of closed-shell effects in delayed neutron systematics.

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7639 MEASUREMENT OF THE RATIO OF ABSORPTION CROSS-SECTION TO FISSION CROSS-SECTION FOR ^{233}U, ^{235}U, ^{239}Pu WITH 0.0011 eV NEUTRONS.

S.J.Cocking.

J. nuclear Energy, Vol. 6, No. 4, 285-90 (May, 1958).

The ratio of the absorption and fission cross-sections for these isotopes has been measured by a new method which yields absolute values. The values obtained at 0.0011 eV are 1.113 ± 0.018; 1.172 ± 0.022 and 1.300 ± 0.040 for the isotopes U^{233}, U^{235} and Pu^{239} respectively.

539.17

7640 ANGULAR AND ENERGY DISTRIBUTION OF FISSION NEUTRONS.

G.A.Bat and L.P.Kudrin.

J. nuclear Energy, Vol. 8, No. 1-3, 74-83 (Nov., 1958). English translation of article in: Atomnaya Energiya, Vol. 3, No. 7, 15 (1957).

The angular distribution of fission neutrons given by the statistical model of the nucleus is calculated, taking account of the angular anisotropy of emission of fission fragments. The latter is represented by the simple expression $1 + k \cos^2 \alpha$. It is assumed that the neutrons are emitted isotropically in the co-ordinate system in which the appropriate fragment is at rest. The ratio P of fission neutron intensities emitted parallel and perpendicular to the primary neutron beam is calculated for U^{238}, the energy range 1-10 MeV being covered for both primary and secondary neutrons. When the fission is considered to be induced by neutrons of the fission spectrum, the mean value of P for U^{238} comes to ~1.13. The energy spectrum of the fission neutrons is also calculated for various values of the incident neutron energy. Anisotropies occurring in the fission of other nuclei may be calculated by the same method.

539.17

7641 ABSOLUTE THERMAL NEUTRON FISSION YIELDS OF U^{233}.

D.C.Santry and L.Yaffe.

Canad. J. Chem., Vol. 38, No. 3, 421-38 (March, 1960).

The absolute fission yields of 22 nuclides formed in the thermal neutron fission of U^{233} were measured radiochemically. Disintegration rates were measured by 4π β-proportional counting techniques. The identity of each nuclide was established by chemical separations and decay characteristics as determined by 4π β-counting and γ-ray scintillation spectrometry. The reaction $Co^{59}(n,\gamma)Co^{60}$ was used as a neutron flux monitor. Yields were calculated on the basis of $\sigma f(U^{233})/\sigma c(Co^{59}) = 524/36.3$.

539.17

7642 THE ENERGY DEPENDENCE OF THE FISSION-NEUTRON YIELD PER NEUTRON ABSORBED IN U^{233} OVER THE RANGE 0.025-2.2 eV.

J.E.Sanders, H.M.Skarsgard and C.J.Kenward.

J. nuclear Energy, Vol. 5, No. 2, 186-91 (1957).

The energy dependence of η, the fission neutron yield per neutron absorbed in U^{233} has beeen measured from 0.025 to 2.2 eV using a crystal spectrometer. Up to 1.3 eV, η was found to remain within ±2% of its value at thermal energies; above 1.3 eV, η decreases and at 2.16 eV has fallen to 80% of its thermal value.

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7643 EFFECTIVE FISSION CROSS-SECTIONS OF ^{233}U, ^{235}U, ^{239}Pu, AND ^{240} Pu IN THE NEUTRON ENERGY RANGE 30 keV-5 MeV.

G.A.Dorofeev and Y.P.Dobrynin.

J. nuclear Energy, Vol. 5, No. 2, 217-25 (1957). English translation of article in Atomnaya Energiya, Vol. 2, 10 (1957).

The effective fission cross-sections of U^{233}, U^{235}, Pu^{239}, and Pu^{240} were measured absolutely for photoneutrons from Sb + Be (~30 keV), Na + D_2O (~250 keV), and Na + Be (~900 keV), from a "mock" fission source, and from Po-α-Be. At 30 keV they are 3.06 ± 0.16, 2.21 ± 0.12, and 1.79 ± 0.11 barns for the first three of these isotopes, respectively. On increasing the neutron energy from 30 keV to 250 keV the cross-sections of U^{233} and U^{235} fall by about 35%, thereafter remaining almost constant; that of Pu^{239} falls 12% and then rises. The fission threshold of Pu^{240} is between 250 keV and 900 keV, the effective cross-sections at 900 keV and 5 MeV being ~1.4 barns.

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7644 FISSION CROSS-SECTIONS AS A FUNCTION OF NEUTRON ENERGY. III. URANIUM-233.

J.E.Sanders, B.T.Price and R.Richmond.

J. nuclear Energy, Vol. 6, No. 1-2, 114 (1957).

The techniques used in this comparison of the fission cross-section of U^{233} with the (n,α), cross-section of B^{10} were identical with those described in papers I and II of this series (Abstr. 7697-8 of 1956). The results are given in the form of a table and a graph.

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7645 RELATIVE MEASUREMENTS OF THE MEAN NUMBER OF NEUTRONS EMITTED PER FISSION INDUCED IN ^{233}U, ^{235}U, AND ^{239}Pu BY THERMAL NEUTRONS AND "FISSION" NEUTRONS.

V.I.Kalashnikova, V.I.Lebedev and P.E.Spivak.

J. nuclear Energy, Vol. 5, No. 2, 226-9 (1957). English translation of article in Atomnaya Energiya, Vol. 2, 18 (1957).

Ratios have been measured of the values of ν for fission induced in U^{233}, U^{235} and Pu^{239} by thermal and "fission" neutrons. The method was to count the number of coincidences between fission fragments and fission neutrons simultaneously with the total number of fissions. For all three nuclides, ν increases by approximately 10% in passing from the lower energy spectrum to the higher.

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7646 THE NEUTRON TOTAL CROSS-SECTIONS OF URANIUM-234 AND URANIUM-236.

G.J.McCallum.

J. nuclear Energy, Vol. 6, No. 3, 181-90 (1958).

The neutron total cross-sections U^{234} and U^{236} have been measured as a function of energy between 0.01 eV and 20 eV. The absorption and total scattering cross-sections at 2200 m/sec are deduced and the parameters of the first resonance in each isotope calculated.

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7647 THE TOTAL EFFECTIVE CROSS-SECTIONS OF ^{233}U, ^{235}U, ^{239}Pu AND THE FISSION CROSS-SECTIONS OF ^{235}U IN THE RESONANCE REGION.

V.V.Sokolovsky, V.V.Vladimirsky, I.A.Radkevich and A.A.Panov.

J. nuclear Energy, Vol. 5, No. 3-4, 389-401 (1957). English translation of article in Atomnaya Energiya, Vol. 2, 129 (1957).

Cross-section measurements for the interaction between resonance neutrons and fissionable nuclei are of value both for reactor calculations and in the construction of nuclear models. In the present paper measurements of the total cross-sections of U^{233}, U^{235} and Pu^{239}, and of the fission cross-section of U^{235} are described. These were made with a mechanical neutron spectrometer having a resolution of 0.1-0.2 μsec/m in the energy range from 3-5 eV to about 500 eV. Resonance parameters were calculated up to energies of about 30/50 eV where the levels can still be considered resolved.

The product $g\Gamma_n$ of the neutron width Γ_n and the spin weighting factor (g) was determined for these resonances and the total width was found for fairly strong levels, the error in width determination is not more than about 50%. For resonances of U^{235} in the range from 2.5-20 eV, the ratio of the fission width Γ_f to the total width Γ was also determined.

539.17

7648 ^{235}U FISSION PRODUCT YIELDS IN THE RARE EARTH REGION.

V.K.Gorshkov, R.N.Ivanov, G.M.Kukabadze and I.A.Reformatsky.
J. nuclear energy, Vol. 8, No. 1-3, 69-73 (Nov., 1958). English translation of article in: Atomnaya Energiya, Vol. 3, No. 7, 11, (1957).

Results are given of measurements of fission product yields from U^{235} made by an integral mass spectroscopic method allowing simultaneous determination of the concentrations of several elements in a mixture. Using this method, the yields of La^{139}, Pr^{141}, Pm^{147} and Pm^{149} were measured for the first time. Absorption cross-sections of Pm^{147} and Sm^{147} are calculated from the data and a lower limit for the absorption cross-sections of Sm^{149} is estimated.

539.17

7649 DELAYED NEUTRONS FROM FISSIONABLE ISOTOPES OF URANIUM, PLUTONIUM AND THORIUM.

G.R.Keepin, T.F.Wimett and R.K.Zeigler.
J. nuclear Energy, Vol. 6, No. 1-2, 1-21 (1957).

The periods, relative abundances, and absolute yields of delayed neutrons from "fast" fission of six nuclides (U^{235}, U^{233}, U^{238}, Pu^{239}, Pu^{240}, and Th^{232}) and thermal fission of three nuclides (U^{235}, U^{233}, and Pu^{239}) have been measured. "Godiva," the bare U^{235} metal assembly at Los Alamos, was the neutron source. Six exponential periods were found necessary and sufficient for optimum least-squares fit to the data. Despite evident perturbations, general agreement among delayed neutron periods was obtained for all nuclides. Measured absolute total yields in delayed neutrons per fission (for the pure isotopes) are: U^{235}, 0.0165 ± 0.0005; U^{233}, 0.0070 ± 0.0004; U^{239}, 0.0412 ± 0.0017; Pu^{239}, 0.0063 ± 0.0003; Pu^{240}, 0.0088 ± 0.0006; Th^{232}, 0.0496 ± 0.0020. Representative of general delayed neutron periods (half-lives) and abundances are the U^{235} fast-fission data of half-lives (secs) and relative abundances (%) respectively: 54.51 ± 0.94, 3.8 ± 0.3; 21.84 ± 0.54, 21.3 ± 0.5; 6.00 ± 0.17, 18.3 ± 0.6; 2.23 ± 0.06, 40.7 ± 0.7; 0.496 ± 0.029, 12.8 ± 0.8; 0.179 ± 0.017, 2.6 ± 0.3. These data have been corroborated in detail by independent period versus reactivity measurements on the "Godiva" assembly. Period and abundances values for the various nuclides are compared and several mechanisms for perturbation of measured delayed neutron parameters are discussed.

539.17

7650 FRACTIONATION PHENOMENA IN NUCLEAR WEAPONS DEBRIS. K.Edvarson, K.Löw and J.Sisefsky.

Nature (London), Vol. 184, 1771-4 (Dec. 5, 1959).

Experiments are described in which the distributions of different fission products in airborne bomb debris were measured. Samples were collected by filtration of 100 to 250 kg of air at a height of 8 to 12 km over central Sweden. It was found that there is a tendency for a large portion of the activity in fresh debris to be concentrated on particles greater than 1 μ in size. On isolating portions of the filtered samples containing highly radioactive particles and examining the γ-spectra it was found that these were richer in $(Zr + Nb)^{95}$ and weaker in Ru^{103} than the remainder of the filter. An explanation of these effects is given in terms of the assumed composition of the fission product mass chains after instantaneous fast fission of U^{238} and chemical fractionation effects occurring thereafter.

R.E.Meads

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THE TEMPERATURE REQUIRED FOR NUCLEAR REACTIONS IN COSMICAL ELECTRICAL DISCHARGES. See Abstr. 6620

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7651 THE RATE OF STRONGLY ENDOERGIC THERMONUCLEAR REACTIONS. J.S.Cheng.

Acta phys. Hungar., Vol. 11, No. 1, 87-90 (1960).

Deduces a formula for endoergic thermonuclear reaction rates, assuming a threshold energy E, above which the cross-section is a constant multiplied by the Gamow barrier penetration factor. It is applicable for mean thermal energy (3/2) $kT < 3E(E/E_0)^{1/2}$, where E_0 is roughly the barrier potential energy.

R.S.Pease

NUCLEAR POWER STUDIES

539.

7652 A LOW-POWER, HIGH-THERMAL-FLUX EXPERIMENTAL NUCLEAR REACTOR.

M.Osredkar and R.Stephenson.
J. nuclear Energy, Vol. 5, No. 2, 210-14 (1957).

An attempt has been made to study, using the simplest method the inside-reflected thermal and fast reactors, with the aim to fin possibly the best solution for a high-thermal-flux, low-power expe mental reactor. Consideration of various arrangements of thermal and fast reactors with central-region reflector (inside-reflector) has shown that a reactor could be designed having a higher therma flux, not by achieving a better heat removal from the reactor core but by keeping the fission only in the fast region and restricting thermalization of neutrons to the inside reflector.

539.

7653 SOME QUESTIONS CONCERNING THE OPERATION O A NUCLEAR POWER STATION. A.N.Grigoriants.

J. nuclear Energy, Vol. 5, No. 3-4, 377-88 (1957). English transla tion of article in Atomnaya Energiya, Vol. 2, 109 (1957).

A discussion is presented of the experience gained in operatin the nuclear electric power station of the U.S.S.R. Atomic Energy Authority. Familiarity with the basic characteristics of the react and the main technical features of the station is assumed. The method of partial recharging of the fuel-channels which lead to a considerable increase in the degree of burn-up of the nuclear fuel (up to 20%), is discussed and compared with the burn-up achieved with complete recharging (11%). By increasing the working time o the fuel elements the method of partial recharging allows them to utilized more efficiently. It is shown that with partial recharging the contents of 1.2 channels are used up per effective day (defined full-power operation of the reactor for 24 hr), while with complete recharging the contents of 1.7 channels are spent. In addition, the use of the method of partial recharging considerably flattens the neutron flux across the reactor. The start-up of the nuclear powe station from "zero" to nominal power is described in detail and th value of the total change of reactivity with temperature is given, which proved to be Δk = 0.027 ± 0.003. It is shown to be possible and advantageous to dispense with the cooling of the side reflector thanks to the smallness of the heat generation in it. Further, the question of the residual heat generation in the fuel channel is discussed. The possibility of extracting the fuel elements without coo ing, 2 hr after shut-down is pointed out. The results of the chemic analysis of the water in the first cooling circuit for various period of operation are given and the insignificance of the quantity of effluent impurities is shown to make possible the abandonment of t use of the bidistillate and the use instead of the condensate from th turbine condenser. Finally, the questions of health physics and radi tion dosimetry are dealt with. The operation of the station and of auxiliary equipment presents no danger either to the staff or to the population of the surrounding district.

539.

7654 SLOW-NEUTRON SPECTRUM MEASUREMENTS FRO THE SWEDISH HEAVY-WATER REACTOR, R1.

K.E.Larsson, R.Stedman and H.Palevsky.
J. nuclear Energy, Vol. 6, No. 3, 222-32 (1958).

A slow chopper with associated time-of-flight equipment has been put into operation at the Swedish reactor, R1. The first task was to determine the shape of the slow-neutron spectrum in the wavelength region from 0.85 A to 11 A. The spectrum of the slow neutrons emerging from an experimental hole is best fitted with a function which is nearly Maxwellian in shape

$$dn = \text{const. } \lambda^{-4.07} \exp -(\lambda_0/\lambda)^2 d\lambda,$$

where $\lambda_0 = 1.66_8$ A and corresponds to a neutron temperature of $(341 \pm 10)^0$ K. The moderator temperature on the same occasion 298^0 K. In subsidiary measurements it has been shown that the pe centage of neutrons below the Be cut-off at 4 A is 5 per cent of the total slow-neutron spectrum, in agreement with the velocity distri tion data. At a reactor power of 600 kW the flux of thermal neutr below the cadmium cut-off at the exit of this experimental channel of radius 12 cm is 3.4×10^8 n/cm^2 sec, the flux below the Be cut- being about 1.3 per cent of this or 4.4×10^6 n/cm^2.

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7655 SOLUTION OF SOME NUCLEAR REACTOR PROBLEMS BY THE RESISTANCE-NETWORK ANALOGUE METHOD. II. REPRESENTATION OF TWO VELOCITY GROUPS.

G.Liebmann.

J. nuclear Energy, Vol. 5, No. 2, 169-85 (1957).

For Pt I, see Abstr. 7703 (1956). The "two-group" partial differential equations for reactors of axial symmetry, and with anisotropic neutron diffusion properties, are converted into finite difference equations. These are then represented by the current flow in resistance networks, the fast- and slow-neutron fluxes being represented by the network voltages. The resulting resistance-network analogue is similar to the "cascaded" network for the solution of the biharmonic equation, but does not involve some of the approximations made in this earlier technique. A convenient and fast measuring technique is described which is used in obtaining the correct solution by an iterative process of readjusting currents fed into the analogue. Experimental work has confirmed that this method leads to solutions in which the neutron fluxes can be determined to better than 1%, and the critical neutron multiplication constant k to better than 0.1%. This work also sheds some light on the truncation error of the solution, and on the convergence rate of the iteration process. Design data for an (r,z) analogue with unequal meshes are given, and the technique for critical size determination is outlined.

539.17

7656 FLUX CHANGES WITH LONG-TERM IRRADIATION IN A REACTOR OF THE CALDER HALL TYPE.

A.Hitchcock, V.E.Price and Y.Shenton.

J. nuclear Energy, Vol. 6, No. 1-2, 66-78 (1957).

A method has been developed for evaluating flux and reactivity changes in a reactor due to long-term changes in the quality of the fuel under irradiation. An account is given of the method, and the results in two simple cases. It is tentatively concluded that the permissible maximum heat output and channel ratings may vary very considerably during the lifetime of a charge, a point of possible importance in reactor design.

539.17

7657 MEASUREMENT OF NEUTRON SPECTRA IN MODERATORS AND REACTOR LATTICES. I. AQUEOUS MODERATORS.

M.J.Poole.

J. nuclear Energy, Vol. 5, No. 3-4, 325-41 (1957).

The application of pulsed source time-of-flight techniques to the measurement of reactor lattice and moderator spectra is described. Results are given for a series of measurements on the spectrum in water loaded with boric acid, and compared with the predictions of theory.

539.17

7658 CONTRIBUTION TO THE THEORY OF SEMI-INTERMEDIARY—SEMI-THERMAL REACTORS WITH Pu-ENRICHMENT.

H.J.Brüchner and H.Kornbichler.

J. nuclear Energy, Vol. 5, No. 3-4, 362-72 (1957). In German.

A study of how resonance absorption of neutrons in Pu^{239}, Pu^{240}, and Pu^{241} affects the properties of a nuclear reactor whose uranium fuel elements have a slight plutonium enrichment. The improvement of the neutron balance and the ensuing increase of the multiplication constant k because of epithermal fission of Pu^{239} and Pu^{241} is derived. Furthermore, the time-variation of the fuel composition is discussed, making due allowance for epithermal build-up and burn-up of U^{238} and the Pu isotopes.

539.17

7659 NEW METHOD OF DETERMINATION OF THE THERMAL UTILIZATION FACTOR OF A [REACTOR] CELL.

A.Amouyal, P.Benoist and J.Horowitz.

J. nuclear Energy, Vol. 6, No. 1-2, 79-98 (1957). In French.

A new formula for the thermal utilization factor is derived, which, while comparable in simplicity to the formula given by elementary diffusion theory, furnishes much more precise results. This is clearly brought out by comparison with the results given by the S_n and spherical harmonics methods.

539.17

7660 THE THERMAL UTILIZATION IN A CLOSE-PACKED LATTICE.

Ya.V.Shevelev.

J. nuclear Energy, Vol. 6, No. 1-2, 121-31 (1957). English translation of article in: Atomnaya Energiya, Vol. 2, No. 3, 217 (1957).

The thermal utilization factor is calculated in diffusion approximation for a lattice of thick cylindrical fuel elements. It is shown that if the lattice is of sufficient symmetry (i.e. if identical fuel elements are placed at the vertices of a regular hexagon, square or equilateral triangle) the use of the equivalent cell method gives a good approximation even if the elements are close-packed. The solution is stated in a form which permits the introduction of non-diffusion corrections.

539.17

7661 THE DEPENDENCE OF BREEDING GAIN AND POWER ON THE LEVEL OF ^{233}U IN THE BLANKET OF A TWO-REGION HOMOGENEOUS REACTOR.

B.P.Rastogi.

J. nuclear Energy, Vol. 6, No. 1-2, 99-103 (1957).

A two-region reactor consisting of a spherical core with highly enriched fuel-salt solution in D_2O and surrounded by a concentric blanket containing ThO_2 -D_2O slurry can be used for the breeding of U^{233}. For this type of reactor, detailed calculations of the dependence of the breeding gain on reactor temperature, core size, and slurry concentration have been made by Visner (1955). In this note the dependence of the breeding gain and power on the level of fissionable material maintained in the blanket is considered. It is found that the breeding gain increases and the heat flux flattens as the level of U^{233} in the blanket increases. The calculations were made for a reactor of fixed size having core radius of 5 ft, blanket thickness of 2 ft, and ThO_2 concentration of 1000 g/l. in D_2O. UO_2SO_4 solution in D_2O was taken as the fuel with 100% pure U^{233}.

539.17

7662 EFFECTIVE THERMAL DIFFUSION LENGTH IN A SANDWICH REACTOR.

B.Davison.

J. nuclear Energy, Vol. 7, No. 1-2, 51-68 (Aug., 1958).

Several, not mutually equivalent, definitions are possible of the effective thermal diffusion length for a lattice reactor. It is here defined by equating the conventional expression for the thermal non-leakage probability (in terms of buckling and the thermal diffusion length) to the value of this non-leakage probability as calculated on the basis of the exact transport theory. With this definition the effective thermal diffusion length is evaluated for the sandwich reactor and compared with expressions for the effective thermal diffusion length currently in use. In the case of diffusion normal to the layers of the sandwich reactor some difficulty arises since in this case the non-leakage probability depends not only upon the size of the system and the lattice characteristics, but also upon the position of the reactor boundaries relative to the cell. This difficulty is overcome by averaging over all possible positions of the reactor boundaries.

539.17 : 539.12

NEUTRON DIFFUSION IN A ONE-DIMENSIONAL URANIUM—WATER LATTICE. See Abstr. 7365

539.17 : 539.12

THE DIFFUSION COOLING OF NEUTRONS IN A FINITE MODERATOR. See Abstr. 7373

539.17 : 539.12

DIFFUSION COOLING OF NEUTRONS IN A FINITE SOLID MODERATOR ASSEMBLY. See Abstr. 7374

539.17 : 539.12

A NEW MULTIGROUP TREATMENT OF NEUTRON DIFFUSION IN REPRODUCING MEDIA. APPLICATION TO THE CORRECTION OF PERTURBATIONS SUFFERED BY THE THERMAL AND FAST FLUXES IN THE NEIGHBOURHOOD OF A REFLECTOR, A NEUTRON SOURCE, OR A DIFFERENT LATTICE. See Abstr. 7356-7

539.17

7663 EPITHERMAL EFFECTS ON CONTROL ELEMENT WORTH.

B.Wolfe.

J. nuclear Energy, Vol. 7, No. 1-2, 71-80 (Aug., 1958).

The Hurwitz—Roe constant-source control-element theory is extended to a two-group treatment in which the epithermal group is fed from a constant source and in turn feeds the thermal group. It is shown that when there are no epithermal fissions, the absorption area for an element black in both the thermal and epithermal group can be written:

$$C = \frac{\tau_2}{\tau_2 - L^2} C_{HR}(\tau) + \frac{L^2}{L^2 - \tau_2} C_{HR}(L)$$

where τ_2 is the age from thermal energies to the epithermal cut-off energy, and C_{HR} is the Hurwitz—Roe one-group absorption area as a function of either L^2 or τ_2. When there are epithermal fissions, the effects of thermal absorption are reduced by the factor

$$[1 - \nu(\Sigma_{f_2}/\Sigma_{r_2})(\Sigma_{SD_1}/\Sigma_{r_1})],$$

where Σ_{f_2} is the epithermal fission cross-section Σ_{r_2} is the epithermal removal cross-section, and Σ_{SD_1} and Σ_{r_1} are respectively the slowing down and removal cross-section in the group which includes all neutrons of energies above the epithermal groups. This effect of the epithermal fission holds whether the control element is thermally black, or both thermally and epithermally black. It is further shown that the methods outlined can be extended to an arbitrary number of groups. The results of this paper allow a multigroup analysis to be made in terms of the simpler one-group work.

539.17

7664 THE EFFECT OF A CURRENT BOUNDARY CONDITION ON CONTROL ROD EFFECTIVENESS. B.Wolfe.

J. nuclear Energy, Vol. 8, No. 1-3, 63-5 (Nov., 1958).

The Hurwitz-Roe one-group, constant source, control rod theory (Abstr. 7701 of 1956) was evolved on the basis of a zero thermal flux condition at the control element surface. By using the methods of the preceding abstract, the effects of a current boundary condition can be examined.

539.17

7665 NEUTRON POISON BY GASEOUS FISSION PRODUCTS. P.C.Davidge and C.J.L.Lock.

J. nuclear Energy, Vol. 6, No. 3, 191-6 (1958).

Calculations have been made of the neutron poisoning caused by gaseous fission products produced under various reactor operating conditions. In particular, the merits of removing the gaseous fission products iodine and bromine, as a means of partial depoisoning, have been considered. It is concluded that if the delay-time before removal of the halogen is less than 1 hr, the poison level would be acceptable even after a long period of reactor operation.

539.17

7666 RESONANCE ABSORPTION IN A CLOSE-PACKED LATTICE. G.V.Petrov.

J. nuclear Energy, Vol. 6, No. 3, 251-4 (1958). English translation of article in: Atomnaya Energiya, Vol. 2, 357 (1957).

One of the most important quantities determining the possibility of a chain reaction in a uranium-moderator system is the probability of resonance absorption in U^{238} of neutrons slowing down from fission to thermal energies. In this paper the expression of Gurevich and Pomeranchuk [Proceedings of the International Conference on the Peaceful Uses of Atomic Energy, Geneva (1955) Vol. 5, p, 466.] for resonance absorption in a lattice of small fuel elements is generalized to the case of a close-packed lattice. The absorption caused by multiple crossing of fuel elements by a neutron is taken into account. The expression derived differs from that given by Gurevich and Pomeranchuk in the term for the blockaded part of the absorption, and the two terms are compared graphically.

539.17

7667 RESONANCE ABSORPTION IN THE POWER STATION REACTOR.

Z.I.Gromova, B G.Dubovsky, A.V.Kamaev and V.V.Orlov.

J. nuclear Energy, Vol. 6, No. 4, 345-50 (May, 1958). English translation of article in: Atomnaya Energiya, Vol. 2, 411 (1957).

One of the important quantities governing the conditions of a chain reaction in a uranium-moderator system is the probability (1—p) that the fission neutrons will undergo resonance absorption during the process of slowing down. At the present day (1—p) cannot reliably be calculated for heterogeneous reactors, so that it has to be determined experimentally. Methods of measuring it are discussed, and the corrections which must be applied for neutron leakage, uranium fission and resonance capture are considered. These corrections are substantial in the case of the power station reactor, which operates with uranium containing 5% U^{235}. The resonance escape probability p for this reactor is calculated by three methods and found to be 0.900 ± 0.015.

539.17

7668 RESONANCE FLUX MEASUREMENT WITH ACTIVATION PROBES. W.Männer and T.Springer.

Nukleonik, Vol. 1, No. 9, 337-41 (Dec., 1959). In German.

When thicker resonance absorption probes are used to determine neutron flux, a self-shielding factor has to be introduced. T factor allows for the flux depression produced by the probe and th self-absorption by the probe of β-particles, which effects counts for the β-activation. The resonance activation inside the probe is calculated as a function of penetration depth and integrating this o the probe thickness, the self-shielding factors G(d,o) and G(d,β) (for γ- and β- counting respectively) were calculated. These resu were confirmed experimentally with indium probes and by conside ation of the results of other authors.

D.H.Lo

539.

7669 THE TRANSFER FUNCTION OF A STEADILY DIVERGING REACTOR. R.Potter.

J. nuclear Energy, Vol. 6, No. 4, 291-9 (May, 1958).

In the design of automatic control systems which operate a diverging reactor, e.g. automatic start-up systems, a knowledge o the transfer function of the reactor is required. General expressi for the gain and phase shift of a steadily diverging reactor as func tions of frequency are derived. Numerical values have been computed for a reactor with six groups of U^{235} delayed neutrons. "Doubling times" of 1, 5 and 20 sec and mean neutron lifetimes o 10^{-3}, 10^{-4} and 10^{-6} sec have been considered and results for these values are shown graphically. The results show that the transfer function of a diverging reactor is significantly different from that a reactor in the steady state. The differences are of such a natur as to decrease the phase and gain margins of stability of the contr system. The additional stability margins required can be found fro the graphs.

539.

7670 ON THE EFFICIENCY OF A CONCENTRIC CUT-OFF ROD OF A THERMAL REACTOR AS A FUNCTION OF THE INSERTED LENGTH OF THE ROD. G.M.Schindler.

J. nuclear Energy, Vol. 8, No. 1-3, 18-32 (Nov., 1958).

The problem considered is that of determining the efficiency c a partially inserted control rod of a thermal reactor by calculating the buckling. Since, according to one-group theory, this buckling i the smallest eigenvalue of the differential equation for the thermal neutron flux with the corresponding boundary conditions, it is deri from a classical variational problem.

539.

7671 THERMAL STRESSES IN REACTOR SHELLS DUE TO γ-IRRADIATION. M.J.Hillier.

J. nuclear Energy, Vol. 8, No. 1-3, 33-47 (Nov., 1958).

Gives methods of calculating the temperatures and stresses i shells forming the pressure vessel or thermal shield of a nuclear reactor. Is is assumed that the γ-ray currents are known on the inner surface of the shell. The heating and stress effects are considered, with particular reference to (a) temperature boundary con ditions, (b) limitations of the flat slab approximation to the stress in hollow cylinders and spheres.

539.

7672 THERMAL STRESSES IN REACTOR SHELLS DUE TO THERMAL NEUTRON IRRADIATION. I. M.J.Hillier.

J. nuclear Energy, Vol. 8, No. 4, 187-96 (Jan., 1959).

Assuming that the thermal neutron flux through a flat slab can be expressed as the sum of exponential terms, the heating effects due to capture γ-ray absorption are calculated. Curves are prese for total heat absorbed, peak temperature and peak thermal stress for a simple attenuation of neutrons through the slab. The results are applicable to the heating effects in pressure vessel shells.

539.17 : 536

STUDY OF CLADDING PROCESSES FROM THERMAL CONTACT POINT OF VIEW. See Abstr. 6965

539.

7673 ON CALCULATIONS FOR CYLINDRICAL REACTORS. V.K.Saulev.

J. nuclear Energy, Vol. 8, No. 1-3, 100-1 (Nov., 1958). English translation of article in: Atomnaya Energiya, Vol. 3, No. 7, 53 (19

539.

7674 EFFECT OF NUCLEAR RADIATION ON ENGINEERIN MATERIALS. A.H.Cottrell.

J. Brit. Nuclear Energy Conf., Vol. 5, No. 2, 64-77 (April, 1960).

The importance of radiation damage in materials for use in nuclear power reactors is emphasized and an account is given of arious types of radiation damage in such materials. The displacement of atoms by nuclear radiation is briefly discussed and examples re shown of recent electron microscopical photographs of radiation amage in materials. A discussion is given of radiation damage in raphite and the importance of stored energy as a reactor problem. he effect of displaced atoms in producing radiation hardening in etals and radiation embrittlement in structural steels is emphasized and discussed in relation to reactor pressure-vessels. roblems of growth, wrinkling, creep, and inert fission gases in ranium are considered in relation to the life of reactor fuel elements.

539.17

7675 THE PREPARATION OF BISMUTH FOR USE IN A LIQUID-METAL FUELLED REACTOR. G.W.Horsley.

. nuclear Energy, Vol. 6, No. 1-2, 41-52 (1957).

Analyses of and values of the pile neutron capture cross-section 38-39 mbarns) of samples of commercial refined bismuth indicate hat chlorine is the most deleterious impurity likely to be found in he material. Study of the bismuth-oxygen-chlorine system suggests hat the concentration of this element may be reduced to about 3 p.p.m. by oxidation and filtration, the residual chlorine remaining n solution as bismuth oxychloride. This concentration may be reduced to less than 1 p.p.m. by treating the metal with hydrogen at 50°-600°C and to between 1 and 2 p.p.m. by gettering with either alcium or magnesium.

539.17

7676 ON THE POSSIBILITY OF PRODUCING THERMONUCLEAR REACTIONS IN A GAS DISCHARGE.

.V.Kurchatov.

. nuclear Energy, Vol. 4, No. 2, 193-202 (Feb., 1957). English ranslation of article in Atomnaya Energiya, Vol. 1, No. 3, 65 (1956).

Text of a lecture at Harwell in 1956 (see Abstr. 3974 of 1956), utlining early Russian attempts to produce controlled thermonuclear eactions. C.G.Morgan

539.17

7677 RESEARCH ON CONTROLLED THERMONUCLEAR REACTIONS AT THE ATOMIC ENERGY INSTITUTE OF HE USSR ACADEMY OF SCIENCES. I.V.Kurchatov.

. nuclear Energy, Vol. 8, No. 1-3, 168-75 (Nov., 1958). English ranslation of article in: Atomnaya Energiya, Vol. 5, No. 2, 105-10 1958).

The principle of the so-called adiabatic trap, wherein a plasma may be contained by the action of magnetic "stoppers', is explained, and the possibility of maintaining a thermonuclear reaction in such a trap is examined. The required plasma temperature for a D-T reaction is ~100 keV, and for a D-D reaction is ~1 MeV. A description is given of Ogra, the largest Soviet machine constructed to study these predictions. Obstacles still to be surmounted include various forms of plasma instability and difficulties in realising the adiabatic condition.

539.17

7678 THE DIRECT CONVERSION OF THERMONUCLEAR ENERGY TO ELECTRICAL POWER IN THE STABILIZED PINCH. R.J.Bickerton and J.D.Jukes.

J. nuclear Energy, Vol. 8, No. 4, 206-14 (Jan., 1959).

A method is suggested whereby the energy liberated by the thermonuclear reactions in a stabilized, pinched discharge may be converted directly into electrical power. Physical criteria are derived which must be satisfied by the discharge. A comparison is made between the direct conversion method and one in which an external heat cycle is used.

ATOMS

539.18

7679 ELECTRON GROUPS IN THE PERIODIC SYSTEM OF THE ELEMENTS IN THE STATISTICAL THEORY OF ATOMS. T.Tietz.

Ann. Phys. (Leipzig), Folge. 7, Vol. 5, No. 3-4, 237-40 (1960). In German.

Following the work of Theis (Abstr. 3960 of 1955) and using the present author's previous approximations (Abstr. 3983 of 1955), a closed analytical expression is derived for the lower limits of the atomic numbers at which the s-, p-, d-, f- electrons first appear. The total number of electrons in the atom is also calculated.

P.Roman

539.18

7680 A PERTURBATION CALCULATION BASED ON AN EXTENDED STATISTICAL MODEL FOR ATOMS.

P.Gombás.

Acta phys., Hungar., Vol. 8, No. 3, 305-14 (1958). In German.

A perturbation calculation improved by the inclusion of the Weizsäcker correction and the kinetic energy correction previously derived by the author is carried out for the statistical model for atoms. W.J.Orville-Thomas

539.18

7681 THE STATISTICAL THEORY OF COMPRESSED ATOMS. P.Gombás.

Acta phys. Hungar., Vol. 8, No. 3, 321-58 (1958). In German.

When the statistical theory of compressed atoms is extended by means of the Weizsäcker correction the results differ considerably from those obtained using the Thomas—Fermi (T-F) and Thomas—Fermi—Dirac (T-F-D) theories. With increased compression the energy of the atoms does not remain constant as indicated by the T—F and T—F—D theories but first decreases and then rises very steeply after passing through a minimum. Revised relations are derived to replace those obtained using the T—F and T—F—D models.

W.J.Orville-Thomas

539.18

7682 SOLUTION OF THE SCHRÖDINGER EQUATION OF TWO-ELECTRON ATOMS. III. CONTINUATION OF THE METHOD. SYMMETRICAL S-STATES. G.Munschy.

J. Phys. Radium, Vol. 18, No. 10, 552-8 (Oct., 1957). In French.

For Pt II see Abstr. 8423 (1957). In the Schrödinger equation of two-electron atoms, the problem of the eigenvalues has been reduced to the solution of a linear and homogeneous system of an infinity of unknown quantities, which are used to expand the solution in terms of a complete set of orthogonal functions. The elements of the symmetrical matrix of the linear system have been calculated next. The eigenvalues of the energy are the squares, with negative sign, of the roots of the determinant. The convergence of this procedure has been checked numerically.

539.18 : 539.11

7683 QUASI-CLASSICAL SOLUTIONS OF THE RADIAL DIRAC EQUATIONS. N.I.Zhirnov.

Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1619-25 (Dec., 1959). In Russian.

An extension of the WKB method, which is applicable to solution of the radial Dirac equations for bound states of electrons in an atom, is considered. Approximate solutions of the Dirac equations are expressed in terms of solutions of similar equations for an electron in a hydrogen-like atom. A method for representation of the approximate solutions in analytical form is given. The fine structure of the M terms of the mercury atom is calculated with allowance for the effect of screening of the nucleus field.

539.18

7684 THE K-SHELL IONIZATION OF ATOMS BY HIGH-ENERGY ELECTRONS.

A.M.Arthurs and B.L.Moiseiwitsch.

Proc. Roy. Soc. A, Vol. 247, 550-6 (Oct. 21, 1958).

An expression for the cross-section for K-shell ionization of atoms by electrons is obtained by using Møller's relativistic modification of the Born approximation. Results are presented for the elements with atomic numbers less than 30. For nickel the calculated cross-sections are in good agreement with those measured by Kirkpatrick and his collaborators, a marked improvement due to the allowance for relativistic effects being found at high energies of impact. The normalization of the wave function of the ejected electron is discussed in the appendix.

539.18

7685 THE MATRIX ELEMENTS OF TENSOR OPERATORS FOR CONFIGURATIONS OF THREE EQUIVALENT ELECTRONS. B.R.Judd.

Proc. Roy. Soc. A, Vol. 250, 562-74 (April 7, 1959).

The formulae of Redmond (Abstr. 3753 of 1954) are used to construct expressions for the fractional parentage coefficients relating the configurations 1^3 and 1^2. The explicit occurrence of godparent states is avoided for the quartet states of f^3 and also for a sequence of doublet states. The latter are defined by the set of quantum numbers $f^3WUSLJJ_Z$, where W and U are irreducible representations of the groups R_7 and G_2. Matrix elements of the type $(f^3WUSL\|U^k\|f^3W'U'SL')$, where U^k is the sum of the three irreducible tensor operators u^k corresponding to the three f electrons, are tabulated for k = 2, 4 and 6 and for all values of W, U, S and L. See also following abstract.

539 18

7686 SPIN-ORBIT INTERACTION IN THE CONFIGURATION f^3.

B.R.Judd and R.Loudon.

Proc. Roy. Soc. A, Vol. 251, 127-33 (May 12, 1959).

See preceding abstract. The matrices of the spin-orbit interaction for f^3 are tabulated using the group theoretical classification of the states. The tables are used to assist in assigning LSJ values to the groups of energy levels labelled I and K which have been observed in several neodymium salts, and an account is also given of various Zeeman effects. See also Proc. Roy. Soc. A, Vol. 251, 134-42 (May 12, 1959).

539.18

7687 USE OF FRACTIONAL PARENTAGE COEFFICIENTS IN THE CALCULATION OF PHOTOELECTRIC CROSS SECTIONS.

B.H.Armstrong.

Proc. Phys. Soc., Vol. 74, Pt I, 136-7 (July, 1959).

A simple analytical formula for the $C_{l \pm 1}$ factors required in the evaluation of photoelectric cross-sections is given through the formalism of fractional parentage coefficients.

539.18 : 539.12

7688 A STUDY OF THE PHOTOELECTRIC EFFECT AND ITS APPLICATION TO THE DETERMINATION OF GAMMA-RAY INTENSITIES.

S.Hultberg.

Ark. Fys., Vol. 15, Paper 27, 307-53 (1959).

A beta-spectrometric study of the longitudinal angular dependence (the θ-dependence) of the photoelectric effect is reported. The K, L, and M + N + ... shells of the uranium atom have been studied in the complete angular interval $0 \leq \theta \leq \pi$, at the gamma-ray energies 412, 662, and 1332 keV. The influence on the distributions from the set-up geometry and the scattering is discussed. By carrying out special experiments and performing numerical calculations, using a fast electronic computer, the distorting effects could be partly corrected for. The experimental distributions are compared with available theoretical expressions, and the usefulness of the angular functions for (a) the study of relative gamma-ray intensities; (b) the determination of absolute internal conversion coefficients; and (c) the absolute measurement of photoelectric cross-sections is discussed. The absorption ratios 79.5 ± 0.6% (K-shell), 14.8 ± 0.5% (L-shell), and 5.7 ± 0.3% (M + N + ... shells) were found for the uranium atom, independently of energy, giving $\tau_a/\tau_K = 1.26 \pm 0.02$. The accuracy of available photoelectric cross-sections is discussed and is considered to be about 5%. Practical formulae are given for the correct deduction of gamma-ray intensities from photolines. For the latter purpose the measured angular functions are given numerically in a table, for all angles θ. The case of rectangular shapes of the gamma-ray source and the converter is considered, with no restrictions being imposed on the relative dimensions, i.e. the source may even be larger than the converter. The latter generalization is valid inside an approximation that is fulfilled in most practical cases. Apart from the errors in the evaluation of the photoline intensities and in available τ_K-values the application of the present technique to the analysis of photolines is expected to be accurate to within 1-5%, depending on the geometry and the accuracy in the determination of certain parameters. The method for taking the finite dimensions of the source-converter geometry into account has been tested experimentally and was found to be satisfactory. From the tabulated angular functions, K/L, K/(M + N + ...) and L/(M + N + ...) ratios for external conversion in uranium can be obtained for any practical source-converter geometry.

539.18

7689 SYSTEMATIC STUDY OF ELECTRON BINDING ENERGIES OF SOME FOURTH AND SIXTH PERIOD ELEMENTS BY MEANS OF THE PHOTO ELECTRON METHOD.

E.Sokolowski.

Ark. Fys., Vol. 15, Paper 1, 1-30 (1959).

A new precision method of measuring electron binding energies is used in a systematic study of K energies in the fourth and L energies in the sixth period of the period table. The results are compared to those obtained by the conventional X-ray absorption meth Discrepancies are observed in some cases, which motivates a reconsideration of the fundamental processes involved in the two methods. The use of infinitely thick sources in β-spectroscopy is demonstrated.

539.18 : 539

7690 ENERGY SHIFTS OF L-LEVELS IN SOME 5th PERIOD ELEMENTS DUE TO OXIDATION AND ALLOYING.

C.Nordling.

Ark. Fys., Vol. 15, Paper 21, 241-50 (1959).

The effect of oxidation and alloying on L-levels in cadmium ar tin has been studied by means of the photo electron method. The L and L_{III} energies of Cd are shown to be lower by 0.8 and 0.6 eV respectively in the oxide than in the pure metal. Conversely, in th tin oxides SnO and SnO_2 the Sn L energies are found to be around 1 eV higher than in the metal. No shift is observed in the SnAu all Infinitely thick as well as thin converters have been used.

539.1

7691 K AND L ENERGY LEVELS IN SOME FOURTH AND FIFTH PERIOD ELEMENTS.

C.Nordling.

Ark. Fys., Vol. 15, Paper 31, 397-429 (1959).

The photo electron method has been applied to a study of the binding energies of K and L electrons in the elements copper, zi gallium, germanium and selenium, and L binding energies in the elements rhodium through tellurium. Calibration lines are obtaine from "absolute" $B\rho$-determinations, and the relative accuracy in th subsequent measurements is 2×10^{-5}. The results are given together with representative X-ray data in modified Moseley diagrams. Discontinuities are observed in these curves even as new subshells of the free atom start to build-up. Certain discrepancie seem to exist between the energies obtained with the photo electro method and those determined by the conventional X-ray absorption method.

539.1

7692 ELECTRON BINDING ENERGIES IN URANIUM.

C.Nordling and S.Hagström.

Ark. Fys., Vol. 15, Paper 32, 431-43 (1959).

The L_{III}, $M_{II}-M_V$ and N_I-N_V level energies in uranium have been measured with the photo electron method. Only a minority of the corresponding X-ray absorption edges have been observed. Th binding energies of these shells, which range from 17 keV down to 700 eV, have been determined in this study with an accuracy of a few tenths of an electron volt. Energy values of the K and L level are deduced by adding energies of X-ray lines to the pertinent binding energies as measured in the present investigation, and an observed discrepancy for the L_{III} energy is discussed.

539.

7693 ON THE ENERGY OF A STATISTICAL ATOM MODEL IN WHICH THE ELECTRONS ARE GROUPED ACCORD TO THEIR PRINCIPAL QUANTUM NUMBERS.

P.Gombás and K.Ladányi.

Acta phys. Hungar., Vol. 7, No. 2, 263-6 (1957). In German.

On the basis of the authors' earlier work (Abstr. 1519 of 1957) the total binding energies of the electrons is calculated for the ine gases Ne, A, Kr, and Xe. The results are in good agreement with the semi-empirical values of Slater. [The values given agree to within about 3% with those calculated from ionization potentials, bu are tabulated to 1 part in 10^5]. P.A.Youn

539.1

7694 RESEARCH ON THE LEVELS OF He BY OPTICAL SPECTROSCOPY AT LOW TEMPERATURE.

J.Brochard, R.Chabbal, H.Chantrel and P.Jacquinot.

J. Phys. Radium, Vol. 18, No. 10, 596-602 (Oct., 1957). In French

The accuracy of the determination of the fine structure of He^4 (levels: 2 ^3P, 3 ^3P, 3 ^3D) given in a previous work, has been increased and measurements extended to 4 D, using a Fabry—Perot spectrometer scanned by pressure. The accuracy has been increa by using a hollow cathode cooled by liquid helium below the λ-point Records have been obtained with currents as low as 10 to 100 μA (power: 2 to 2 mW), while the resolving power of the instrument about 2×10^6. The temperature of the discharge derived from the Doppler width of the components was 4 to 11°K.

539.

7695 IONIZATION POTENTIALS AND LAMB SHIFTS OF THE GROUND STATES OF ^4He AND ^3He.

G.Herzberg

Proc. Roy. Soc. A, Vol. 248, 309-32 (Nov. 25, 1958).

To obtain an experimental value for the Lamb shift of the ground state of helium, the wavelengths of the far ultraviolet lines 584.3 (1^1S-2^1P), 537.0 (1^1S-3^1P) and 591.4 A (1^1S-2^3P) of He^4 have been redetermined and those of He^3 have been measured for the first time. The standards used were lines of C^+ and A^+ in the region 610 to 520 A which were derived by means of the combination principle from lines at longer wavelengths. The final results for the wavelengths of the He^4 lines are 584.3339, 537.0293 and 591.4121 A with an estimated accuracy of ±0.0005 A. For He^3 the corresponding figures, obtained by adding the measured shifts to the He^4 wavelengths, are 584.3640, 537.0577 and 591.4466 A. The term values of the upper states of these lines relative to the ionization limit have been redetermined by a new measurement of the Bergman series 3^3D-n^3F, of the intercombination lines 2^3P-3^1D and 2^1P-3^3D and a re-measurement of the near ultraviolet 2^1P-n^1D and 2^3P-n^3D series. Combining these results with those of the far ultraviolet lines, the values for the ionization potentials of He^4 and He^3 are respectively: $198310.8_2 \pm 0.15\ cm^{-1}$, and $198300.3_2 \pm 0.15\ cm^{-1}$. The isotope shift of the ground state, $10.50 \pm 0.05\ cm^{-1}$, agrees closely with the theoretical prediction. Experimental values for the Lamb shift are obtained by comparing the observed ionization potentials with those obtained from the Dirac theory not including quantum electrodynamic effects. Using Kinoshita's 39-parameter value, one finds a Lamb shift of -0.7_9 and $-0.8_2 \pm 0.15\ cm^{-1}$ for He^4 and He^3, respectively.

539.18

7696 RESTRICTED AND UNRESTRICTED HARTREE—FOCK CALCULATIONS FOR ATOMIC LITHIUM.

R.K.Nesbet.

Ann. Phys. (New York), Vol. 9, No. 2, 260-71 (Feb., 1960).

The unsymmetrized unrestricted and several restricted versions of the Hartree—Fock formalism are used in calculations for atomic lithium. The calculations lead to very similar results. This suggests that it is advantageous to use a particularly tractable version of the restricted Hartree—Fock formalism.

539.18

7697 HYPERFINE SPLITTING OF THE LITHIUM GROUND STATE.

L.M.Sachs.

Phys. Rev., Vol. 117, No. 6, 1504-6 (March 15, 1960).

The results of calculations of the hyperfine splitting of the lithium atom ground state are reported. These were done by the Hartree—Fock (HF), unrestricted Hartree--Fock (UHF) and projected UHF approximations to the ground-state eigenfunctions. The exchange polarization effect allowed by the UHF method yields a 34.9% increase in the hyperfine splitting compared to the HF method.

539.18

7698 THEORETICAL DETERMINATION OF THE ELECTRONIC POLARIZABILITY OF LITHIUM, CALCIUM AND SCANDIUM.

M.Sundbom.

Ark. Fys., Vol. 13, Paper 39, 539-47 (1958).

The electronic polarizability α was determined by perturbation methods for Li, Ca^{++}, Ca and Sc. The calculated values of α (in units $10^{-24}\ cm^3$) are: 20 for Li, 0.83 for Ca^{++}, 52-153 for Ca and 154 for Sc. Although these values probably are not very exact, they are, however, certainly of the correct order of magnitude.

539.18

7699 COMPARISON OF CALCULATIONS PERFORMED WITH THE VARIATIONAL METHOD AND THE "SELF CONSISTENT FIELD" METHOD FOR DETERMINING THE ELECTRON STRUCTURE OF THE OXYGEN ATOM.

R.Gáspár and É.Szabó.

Acta phys. Hungar., Vol. 10, No. 2, 157-68 (1959). In German.

A previously introduced (Abstr. 2625 of 1953) potential-field is used to determine the one-electron wave functions and energies of the oxygen atom. P.Roman

539.18

7700 ELECTRONIC CONFIGURATION AND HYPERFINE STRUCTURE OF Pu I.

S.Gerstenkorn.

C.R. Acad. Sci. (Paris), Vol. 250, No. 5, 825-7 (Feb. 1, 1960). In French.

From a study of the hyperfine structure, thirty levels are shown to have J values less than 4, whence it is concluded that the ground state of plutonium is $5f^6 7s^2$. P.A.Young

539.18 : 539.14

7701 THE HYPERFINE STRUCTURE OF THE $3^2P_{3/2}$ STATE OF SODIUM AND THE QUADRUPOLE MOMENT OF ^{23}Na.

J.N.Dodd and R.W.N.Kinnear.

Proc. Phys. Soc., Vol. 75, Pt 1, 51-60 (Jan., 1960).

Using the double-resonance technique a study has been made of the hyperfine structure of the $3^2P_{3/2}$ state of sodium in a magnetic field sufficiently strong to decouple completely J and I. The values of the hyperfine coupling constants are $a = 18.5 \pm 0.6$ Mc/s and $b = 2.25 \pm 0.4$ Mc/s. The Landé factor for the state is $g_J = 1.3341 \pm 0.0003$.

539.18

7702 MEASUREMENT OF THE LIFETIMES OF THE TERMS 3^1S_0, 3^3P_2, 3^3D_2, 3^1P_1 AND 3^1D_2 OF Ne BY THE METHOD OF DELAYED COINCIDENCES.

A.L.Osherovich and G.M.Petelin.

Dokl. Akad. Nauk SSSR, Vol. 129, No. 3, 544-6 (Nov. 21, 1959). In Russian.

Neon was excited by an electron beam, the successive rectangular pulses lasting ~ 10^{-7} sec with a repetition frequency of 10 kc/s. The number of coincidences between the photomultiplier pulses and the delayed pulses of the generator was studied in time On a semi-logarithmic graph the dependence of the number of coincidences on the time of delay is linear, and the mean lifetime of a term is determined from the slope of this straight line. The determined lifetimes ranged from 4.6 to 11.8×10^{-8} sec. Out of the five lifetimes determined, only two agree well with Griffith's data (Abstr. 1161 of 1934), the other three differing by about 25%. F.Lachman

539.18

7703 A STUDY OF RESONANCE NEUTRALIZATION IN MONATOMIC GASES AND METAL VAPOURS.

R.M.Kushnir, B.M.Palyukh and L.A.Sena.

Izv. Akad. Nauk SSSR, Vol. 23, No. 8, 1007-11 (1959). In Russian.

The experimental method is as described by Palyukh and Sena (Abstr. 8832 of 1950). The authors measured cross-sections for resonance neutralization over the ranges 10-990 eV for argon, krypton and xenon, and 6-650 eV for potassium and caesium. Measurements were made at various vapour pressures. The results obtained are compared with the existing theories; for alkali metal vapours the cross-sections calculated by Firsov (Abstr. 5261 of 1952) give the best agreement with experiment. It is concluded that the cross-section decreases monotonically with increase in energy and with increase in ionisation potential, but no general law is derived. M.G.Priestley

539.18

7704 INVESTIGATION OF THE EFFECT OF THE HYPERFINE STRUCTURE ON POLARIZATION OF μ^--MESONS IN MESIC ATOMS.

L.B.Egorov, A.E.Ignatenko and D.Chultem.

Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1517-23 (Dec., 1959). In Russian.

The angular distributions of electrons from μ^--meson decay of aluminium, phosphorus and carbon mesic atoms were studied with scintillation counters. It is shown that due to interaction of the hyperfine structure there is a decrease of the μ^--meson polarization. The results of the measurements do not contradict the theoretical predictions if depolarization only at the K-orbit of the mesic atom is taken into account. Comparison of the results of the measurement for phosphorus with the results previously obtained for liquid hydrogen shows that the complete depolarization of μ^--mesons observed in hydrogen cannot be explained only by the interaction between the fine and hyperfine structures: an additional mechanism must be assumed (such as the "jumping" of a μ^--meson from one proton to another one with simultaneous transition of the hyperfine structure to a lower state). All experimental data on depolarization of μ^--mesons in various substances can be explained theoretically if it is assumed that in mesic atoms of metals the electron shell does not affect the depolarization of μ^--mesons. The presence of fine and hyperfine structures in mesic atoms is confirmed and this again indicates that the electromagnetic properties of mesons and electrons are similar. The reduction of precession frequency of the mesic nucleus spin by a factor of two, as compared with precession frequency of the free μ-meson spin, observed in experiments with phosphorus, indicates directly that the spin of a negative μ-meson is equal to $\frac{1}{2}$.

539.18

7705 ABUNDANCES OF EVEN-MASS ISOBARS.

A.H.W.Aten, Jr.

Physica, Vol. 25, No. 6, 503-8 (June, 1959).

The sum of the abundances of two isobars, which both have an appreciable abundance, is generally less than it should be to agree with the interpolated value of other normal abundances.

539.18

7706 ON THE MEASUREMENT OF ISOTOPE ABUNDANCE OF LITHIUM WITH MASS SPECTROMETER.

I.Omura and N.Morito

J. Phys. Soc. Japan, Vol. 13, No. 6, 659 (June, 1958).

The Li^7/Li^6 ratio of two different LiCl samples was 12.48 ± 0.05 and 13.69 ± 0.5. The first was commercial the second purified. Transient changes of the measured ratio were noted when the filament temperature was suddenly altered. H.London

539.18

7707 THE MASSES OF ^{13}C, ^{14}N AND ^{15}N.

R.A.Demirkhanov, T.N.Gutkin and V.V.Dorokhov.

J. nuclear Energy, Vol. 7, No. 3-4, 255-63 (Sept., 1958). English translation of article in: Atomnaya Energiya, Vol. 2, 544 (1957).

New measurements of the C^{13}, N^{14}, and N^{15} isotope masses are reported. Internal consistency is shown by the mass values derived from different doublet systems. The measurements were carried out under conditions which excluded systematic error. A precise method to adjust the ion-focusing system is described. The values are found to be 13.007 491 ± (3×10^{-6}), 14.007 527 ± (4×10^{-6}) and 15.004 890 ± (5×10^{-6}) mass units for O^{13}, N^{14} and N^{15} respectively, and these are in good agreement with those published previously by Nier et al. These results are higher than the average values obtained from nuclear reactions and statistical analysis. The discrepancy is explained by inaccuracies in the Q values used in the calculation of the masses of the original isotopes n_0, H, D, He^4 and C^{12} and the isotopes C^{13}, N^{14} and N^{15}.

539.18

7708 THE MASS OF ^3He.

R.A.Demirkhanov, T.I.Gutkin and V.V.Dorokhov.

J. nuclear Energy, Vol. 6, No. 4, 371 (May, 1958). English translation of article in: Atomnaya Energiya, Vol. 2, 469 (1957).

The isotopic mass of He^3 has been determined by mass spectrometry as 3.016 974 ± 2 mass units, using the apparatus described in a previous paper [J. nuclear Energy, Vol. 3, 351 (1956)]. To check the consistency of the measurements, mass determinations were made for the doublets H^3—He^3 and HD—He^3, and the doublet HD—H^3 was also measured. The lines NH^{14}—NH_2^{14}—NH_3^{14} were used to calibrate the mass scale. From the results of this work, the Q-values for a number of nuclear reactions have been calculated, and these are compared with directly measured values.

539.18

7709 THE SEPARATION OF THE ISOTOPES OF POTASSIUM BY EVAPORATION FROM MOLTEN POTASSIUM IN VACUUM.

B.P.Konstantinov and V.S.Rylov.

Zh. tekh. Fiz., Vol. 29, No. 6, 778-83 (June, 1959). In Russian. English translation in: Soviet Physics — Technical Physics (New York), Vol. 4, No. 6, 706-12 (Dec., 1959).

A study was made of the separation of the isotopes of potassium that occurs between molten and gaseous potassium on evaporating the metal in vacuum. The ideal conditions of evaporation under which the evaporated particles do not return to the liquid phase were examined and realized; they are that the isotopic composition of the liquid phase remains uniform, and that its surface remains clean during evaporation. The isotopic composition of potassium was analysed by the flotation method. It is shown that with inadequate mixing of the molten potassium the isotopic effect decreases. The coefficients of separation of the potassium isotopes under ideal conditions of evaporation is $\alpha = 1.024(4) \pm 0.0010$. Within the limits of error, this value is close to the calculated coefficient of separation $\alpha_{max} = 1.0258$.

539.18

7710 APPROXIMATE CROSS-SECTIONS FOR INELASTIC COLLISIONS OF ELECTRONS WITH ATOMS. I. ALLOWED TRANSITIONS.

S.N.Milford.

Astrophys. J., Vol. 131, No. 2, 407-12 (March, 1960).

The threshold and large energy properties of cross-sections are combined with the energy derivative of the cross-section at its maximum. The resulting formula relates the maximum cross-section to the energy ϵ_1, at this maximum. The multiple expansion then gives a simple formula within 10% of the Born approximation maxima for some illustrative transitions of hydrogen induced by electron impact. Choosing ϵ_1, the approximate formula gives the momentum cutoff in the Bethe approximation. The Bethe and threshold shape is then checked against electron plus hydrogen atom Born cross-sections for allowed transitions. The simple formula gives (a) the Born maximum within a factor of 2 and (b) the Born approximation for all energies within a factor of 3. Thus, when the dipole moment is known from experiment or calculation, the approximate cross-section for any allowed atomic transition can be found at all energies by several minutes' calculation.

539.18

7711 ELECTRON—NUCLEUS HYPERFINE INTERACTION IN ATOMS.

R.A.Ferrell.

Amer. J. Phys., Vol. 28, No. 5, 484-6 (May, 1960).

It is pointed out that the so-called "hyperfine interaction" between the magnetic moment of a nucleus and the spins of the surrounding electrons is completely classical in origin. Quantum mechanics is irrelevant and not necessary to the understanding of this coupling. A simple derivation, based only on classical static magnetism, is given of Fermi's formula for the interaction energy.

539.18

7712 ON THE CHOICE OF THE ATOMIC ELECTRON (WAVE) FUNCTIONS IN SCATTERING PROBLEMS. II.

V.Veldre.

Latv. PSR Zinat. Akad. Vestis, No. 11 (148), 69-71 (1959).

Continuing the work of Pt I [Abstr. 4164 of 1960] the author discusses the possibility of applying radial wave-functions of variou types for the solution of the electron-scattering problem on atoms i the framework of Born's method. P.Roman

539.18

7713 ELASTIC SCATTERING OF LOW-ENERGY ELECTRON BY THE THOMAS—FERMI ATOM.

L.B.Robinson.

Phys. Rev., Vol. 117, No. 5, 1281-3 (March 1, 1960).

A detailed study of the problem has been made. The scattering lengths were determined for essentially all atoms in the periodic table within the framework of the Thomas—Fermi approximation. The scattering length is not a monotone function, but rather a period (roughly) function of the atomic number of the scattering atom. Both positive and negative scattering lengths are found. The effect of the sign and magnitude of the scattering length on the shape of the cross-section versus energy curve is studied. It is observed that atoms with negative scattering lengths have very low cross-sections for some energy of the incoming electrons; such is not the case with all atoms having positive scattering lengths.

539.18

7714 SMALL ANGLE SCATTERING OF ELECTRONS.

I.Berkes and I.Demeter.

Nuclear Phys., Vol. 15, No. 3, 421-35 (March (1), 1960).

The small-angle scattering of 615 keV electrons was studied on N, A, Kr and Xe gases. It was found that if the electron cloud of atoms is considered in Hartree representation, for angles $\theta < 1.5 \times 10^{-3}$ radians, covered by the measurements, the differential cross sections for elastic and inelastic scattering are in agreement with the theory. The screening of elastic scattering being represented by an exponential factor $e^{-r/a}$, the screening parameters

$$a = (1.23 \pm 0.067)a_0Z^{-1/3} \text{ and } a = (1.195 \pm 0.070)a_0Z^{-1/3}\,\frac{Z}{Z-1}^{\,2/3},$$

respectively, give the best representation of the experimental result

539.18

7715 ON THE THEORY OF ELASTIC COLLISIONS BETWEEN ELECTRONS AND HYDROGEN ATOMS.

L.Castillejo, I.C.Percival and M.J.Seaton.

Proc. Roy. Soc. A, Vol. 254, 259-72 (Feb. 9, 1960).

A hydrogen atom in the ground state scatters an electron with kinetic energy too small for inelastic collisions to occur. The wave function $\Psi(r_1, r_2)$ of the system has boundary conditions at infinity which must be chosen to allow correctly for the possibilities of both direct and exchange scattering. The expansion

$$\Psi = \sum_{\gamma} \psi_\gamma(r_1)F_\gamma(r_2)$$

of the total wave-function in terms of a complete set of hydrogen ato wave-functions $\psi_\gamma(r_1)$ includes an integration over the continuous spectrum. It is shown that the integrand contains a singularity. The explicit form of this singularity and its connection with the boundary conditions are examined in detail. The symmetrized functions $\Psi^\pm$ may be represented by expansions of the form

$$\sum_{\gamma}\{\psi_\gamma(r_1)\,G_\gamma^\pm(r_2) \pm \psi_\gamma(r_2)\,G_\gamma^\pm(r_1)\},$$

where the integrand in the continuous spectrum does not involve singularities. Finally, it is shown that because all the states ψ_γ of the hydrogen atom are included in the expansion, the equation satisfied by F_1, the coefficient of the ground state, contains a polarization potential which behaves like $-\alpha/2r^4$ for large r and is independent of the velocity of the incident electron.

539.18

7716

ENERGIES OF VARIOUS INTERACTIONS BETWEEN HYDROGEN AND HELIUM ATOMS AND IONS.

R.J.Fallon, E.A.Mason and J.T.Vanderslice.

Astrophys. J., Vol. 131, No. 1, 12-14 (Jan., 1960).

A compilation is made of those interactions between hydrogen and helium atoms and ions whose potential curves are well established by virtue of being based on experimental data or on essentially exact quantum-mechanical calculations. These potential curves have been fitted with well-known empirical forms which should be useful in calculations of transport properties involving these interactions.

539.18 : 539.12

7717

THE WIDTH AND INTENSITY DISTRIBUTION OF THE COMPTON LINE.

Z.Csoma.

Acta phys. Hungar., Vol. 10, No. 4, 451-4 (1959). In German.

Experiment shows that Compton scattering leads not to a sharp line but to a narrow band of wavelengths; for Mo Kα radiation scattered by Ne atoms the half width of the band is 0.032 A. This quantity is deduced on theoretical grounds, making use of two models, one due to Konya (Abstr. 2495 of 1950) and the other due to Gombas and Ladanyi (Abstr. 1519 of 1957). The results are in fair agreement with experiment but no decision as to the best model can be made. T.Mulvey

539.18

7718

RELATIVISTIC CALCULATION OF THE K–LL AUGER SPECTRUM.

V.N.Asaad.

Proc. Roy. Soc. A, Vol. 249, 555-73 (Feb. 10, 1959).

Extensive relativistic calculations have been carried out for the K–LL Auger spectrum of mercury based on Møller's semi-classical treatment for the interaction of radiation with electrons. Numerical calculations using electronic computers give, for the relative intensities and position of the different lines of the spectrum, values in very good agreement with observation and remove the discrepancies obtained earlier by Massey and Burhop for some of them. It is found that relativistic effects increase the Auger transitions by about 84% and decrease the radiative transitions by about 75%. An approximate estimate for the K-series fluorescence yield ω_K of 0.961 is also obtained.

539.18

7719

EXPERIMENTAL STUDIES OF THE KLL AUGER SPECTRA OF Cu AND Ge.

E.Sokolowski and C.Nordling.

Ark. Fys., Vol. 14, Paper 35, 557-64 (1959).

The energies of the Auger lines of Cu and Ge, belonging to the KLL group, have been determined, and the intensities have been estimated. For both elements, six components could be established in the KLL group. The experimental data are in good agreement with the theoretical results of Asaad and Burhop, as regards the relative energies and intensities. The absolute energies deviate by 40 and 50 eV respectively.

539.18

7720

A NEW METHOD FOR CALCULATING X-RAY K-ABSORPTION SPECTRA.

E.G.Nadzhakov and R.L.Barinskii.

Dokl. Akad. Nauk SSSR, Vol. 129, No. 6, 1279-82 (Dec. 21, 1959). In Russian.

Following earlier work by Kossel, Parrat, Vainshtein and Narbutt relating the fine structure of the K-absorption edge to the optical spectra, the authors consider in more detail the charge distribution in the K-shell, starting from a consideration of 'holes' in the K-shell responsible for the observed spectra. A formula is derived for the atomic absorption coefficients of argon and Zn^{++} and the calculated spectra are compared with those observed. The agreement is sufficiently good to enable the authors to express confidence in their calculations in spite of some approximations that they have been compelled to make. T.Mulvey

539.18 : 539.14

7721

NUCLEAR SHAPE EFFECT ON ISOMERIC SHIFT.

J.Lardinois.

Nuclear Phys., Vol. 15, No. 3, 522-4 (March [1], 1960).

The nuclear isomeric shift $_{49}In^{115}$ III (odd-proton nucleus) and $_{80}Hg^{197}$ (odd-neutron nucleus) were calculated taking account of a collective deformation of the core. Theoretical results agree with experimental data for Hg^{197}.

539.18

7722

ENERGY LEVELS AND SPECTRUM OF NEUTRAL HELIUM (^{4}He I).

W.C.Martin.

J. Res. Nat. Bur. Stand., Vol. 64A, No. 1, 19-28 (Jan.-Feb., 1960).

A table of energy levels based on the most accurate observations now available in given for the neutral He^4 atom. The wavelengths contained in a revised list of He^4 I lines from 320 to 21132 A are also based on the best measurements, over half of them having been calculated from the wavenumber separations of appropriate levels. Several previously disturbing features of the He^4 term scheme are obviated by the revised level values. In a discussion of the experimental results for this spectrum some comparisons with theory are made.

539.18

7723

FREQUENCY SHIFTS IN THE HYPERFINE SPECTRA OF ALKALIS CAUSED BY FOREIGN GASES.

L.B.Robinson.

Phys. Rev., Vol. 117, No. 5, 1275-80 (March 1, 1960).

The pressure shift and the temperature coefficient of the pressure shift are calculated for hyperfine spectra when radiating alkali atoms are perturbed by foreign gases. The method of calculation is based on a suggestion by Margenau (unpublished). Both the pressure shift and the temperature coefficient can be calculated on the basis of potential functions representing intermolecular forces operative when the radiating atom is in the presence of the perturbing atoms. The inert gas atoms are considered explicitly as perturbing atoms. For weak interactions (small perturbing atoms) a Lennard-Jones (6-12) potential is adequate to give excellent agreement between theory and experiment. Helium and neon give rise to weak interactions and the frequency shifts are toward the blue. When the interactions are strong (large perturbing atoms), a simple Lennard-Jones (6-12) potential is no longer adequate to give reasonable agreement between theory and experiment. When higher order attractive terms are included in the interaction, the agreement between theory and experiment is considerably improved. Argon and krypton give rise to strong interactions and frequency shifts toward the red. Numerical values are obtained for the dipole–dipole, dipole–quadrupole, dipole–octupole, and quadrupole–quadrupole terms in the intermolecular interaction. For each pair of interacting atoms there are two parameters to fit two sets of data. For the case of the small perturbing atoms, one of the parameters is just the sum of the gas kinetic radii, so that there is essentially only one parameter which is adjusted to fit two pieces of data. The overall agreement between theory and experiment is very good.

539.18

7724

ULTRAVIOLET EXTENSIONS OF THE ARC SPECTRA OF THE ALKALINE EARTHS: THE ABSORPTION SPECTRUM OF BARIUM VAPOUR.

W.R.S.Garton and K.Codling.

Proc. Phys. Soc., Vol. 75, Pt 1, 87-94 (Jan., 1960).

The absorption spectra of the alkaline-earth metal vapours have been photographed in the quartz ultraviolet and Schumann regions, by means of a 3 m vacuum spectrograph and large King furnace. Considerable extensions of the arc spectra of these elements have resulted, many of the new lines being two-electron transitions. Extreme cases of autoionization and many examples of series perturbations occur. The results are presented for the case of Ba, including assignments for 64 out of about 68 new lines. The presence of a doubly excited level practically coincident with the lowest ionization limit has striking effects on the photoionization cross-section and on the intensities of the high members of the singlet principal series of Ba, which is extended to the m = 37 member.

539.18

7725

PRECISION DETERMINATION OF THE HYPERFINE STRUCTURE OF THE GROUND STATE OF ATOMIC HYDROGEN, DEUTERIUM, AND TRITIUM.

L.W.Anderson, F.M.Pipkin and J.C.Baird, Jr.

Phys. Rev. Letters, Vol. 4, No. 2, 69-71 (Jan. 15, 1960).

The optical polarization method (Abstr. 6469 of 1957), using the resonance radiation of rubidium, was applied to the study of the hyperfine structure of the hydrogen isotopes. The effect of pressure shift due to the buffer gases H_2, He, Ne, and A was determined and the results obtained by extrapolating to zero pressure. Numerical values (Mc/s) for the zero-field hyperfine splittings are:

$$\Delta\nu\,(H^1) = 1420.405\,726 \pm 0.000\,030$$
$$\Delta\nu\,(H^2) = 327.384\,349 \pm 0.000\,005$$
$$\Delta\nu\,(H^3) = 1516.701\,396 \pm 0.000\,030$$

P.A.Young

539.18

7726 THE SOFT X-RAY L_{23} EMISSION SPECTRUM OF MAGNESIUM FROM SOLID AND EVAPORATED TARGETS.

R.S.Crisp.

Austral. J. Phys., Vol. 11, No. 3, 449-52 (Sept., 1958).

Reports spectroscopic studies of the magnesium L_{23} emission band at 250 A. A grazing incidence spectrometer fitted with a photomultiplier detector enabled the changes in the spectrum to be followed without the necessity for analysing a series of photographic plates. Precautions were taken to obtain a clean target surface. A correction was applied for surface contamination layers of carbon. Measurements of edge breadths and wavelength were also made.

A.E.I. Research Laboratory

539.18

7727 THE INFLUENCE OF KRYPTON ON THE 2536.52 A LINE OF MERCURY.

A.Michels, H.De Kluiver and D.Middelkoop.

Physica, Vol. 25, No. 2, 163-70 (Feb., 1959).

The 2536.52 A $(^1S_0-^3P_1)$ line of mercury has been studied in absorption in the presence of krypton up to a density of 190 Am*. Investigations of the shape and the shift of the line have been carried out. At very low densities three satellites were observed at distances of about 34, 73 and 128 cm^{-1} to the violet of the original resonance line. With increase of krypton density the whole pattern shifted to the red. As long as the satellites were clearly distinct the distances between the maxima remained approximately unaltered; at the same time the intensity of the satellites increased. Gradually the pattern changed: first the satellite at 34 cm^{-1} disappeared into the background, then the satellite at 73 cm^{-1} was overshadowed by the outer one, and, finally, above a density of about 150 Am the band at 128 cm^{-1} began to absorb the original resonance line. The absorption measured in the peak of the outer satellite, as well as that at the violet side increased proportional to the krypton density up to 60 Am; a similar phenomenon was found for the red wing of the principal line, from 100 cm^{-1} to at least 300 cm^{-1} from the unperturbed line position, up to 120 Am. The measurements were carried out with unsaturated mercury vapour. Because of the possibility of adsorption of mercury at the steel walls and in view of the qualitative discrepancy between the results for argon concerning the integrated absorption per atom and those of Strijland and Nanassy (Abstr. 12018 of 1959), the experimental values of the integrated absorption coefficient presented are not discussed. [* = 190 amagat = 190 × gas density at S.T.P.]

539.18 : 551.5

7728 LIFE-TIME OF THE ATOMIC OXYGEN 6300 A LINE IN THE AURORAL SPECTRUM.

W.Stoffregen and H.Derblom.

Nature (London), Vol. 185, 27-8 (Jan. 2, 1960).

The delay between the onset of the N_2^+ 4278 A band and of the OI 6300A and 6364 A lines has been measured in twelve auroral observations using a photoelectric recording spectrometer. The average delay time of 110 sec is in excellent agreement with theoretical estimates of the lifetime of the metastable upper level from which the lines originate.

R.W.Nicholls

539.18

7729 ANALYSIS OF THE FIRST SPECTRUM OF RUTHENIUM (Ru I).

K.G.Kessler.

J. Res. Nat. Bur. Stand., Vol. 63A, No. 3, 213-51 (Nov.-Dec., 1959).

The analysis of the first spectrum of ruthenium has been extended with the aid of digital computers. A total of 105 even and 206 odd levels are listed with observed Lande g-factors for 54 even and 148 odd levels. A complete list of approximately 3400 classified lines in the range from 2013 to 11484 A is presented. The ionization limit calculated from a two member series is 59 410 cm^{-1} or 7.364 V.

539.18

7730 SUPPLEMENTARY ZEEMAN DATA FOR THE FIRST SPECTRUM OF RUTHENIUM (Ru I).

J.R.McNally, Jr and K.G.Kessler.

J. Res. Nat. Bur. Stand., Vol. 63A, No. 3, 253-4 (Nov.-Dec., 1959).

Zeeman data are listed for 207 lines between 2400 and 5400 A, all of which have been classified.

539.1

7731 LOW EVEN CONFIGURATIONS IN THE FIRST SPECTR OF RUTHENIUM (Ru I). II.

R.E.Trees.

J. Res. Nat. Bur. Stand., Vol. 63A, No. 3, 255-60 (Nov.-Dec., 1959).

A calculation for the 4d^8, 4d^{7}5s, and 4d^{6}5s^2 configurations of Ru I (Abstr. 10757 of 1959) is repeated in steps. Displacements produced by configuration interaction are evaluated, and departures of term positions from familiar expectations in the absence of configuration interaction are explained. The weaker perturbations produced by second-order effects of the spin—orbit interaction are then determined. It is shown that the neglect of these effects in published hand computations has obscured the remarkably good agreement between theory and observation that is obtainable in spectra of the second long period. The eigenvectors are based on "third-order eigenfunctions" which describe the levels simply, and show the degree of LS-coupling in a more quantitative manner.

539.1

7732 MEASUREMENT OF "OPTICAL" TRANSITION PROBABILITIES IN THE SILVER ATOM.

J.Terpstra and J.A.Smit.

Physica, Vol. 24, No. 12, 937-58 (Dec., 1958).

For 22 spectral lines of the silver atom the probability of spontaneous transition has been derived from measurements of the emission intensity of the line and the population of the correspondin upper level. The excitation medium was the column of a vertical arc discharge in air at atmospheric pressure. The upper electrode (cathode) was a vertical carbon rod; the lower electrode either a carbon rod filled with a mixture containing silver, or a silver rod. The arc length was $1\frac{1}{2}$ cm, the current about 5 A and the axial field strength about 30 V/cm. The spectrum showed cyanogen bands and silver lines, the intensities of which were measured photographicall The arc temperature was derived from intensity ratios of the CN bands; in most cases the temperature was 5000 to 6000°K. For every exposure the relative populations of the upper levels of the silver lines were derived from the temperature. From these populations and the measured intensities of the silver lines the relative transition probabilities of the lines were calculated. The results are compiled in a table. As the concentration of the silver vapour in the arc was not accurately known, reliable values of the absolute transition probabilities could not be derived and only a rough estimation has been made. It has been established that in the relative measurements there were no disturbing effects of ionizatio of the vapour in the arc, nor of self-absorption of the measured silv lines. The transition probabilities of the resonance lines have not been measured.

539.1

7733 A PRELIMINARY LIST OF LEVELS AND g-VALUES FOR THE FIRST SPECTRUM OF THORIUM (Th I).

R.Zalubas.

J. Res. Nat. Bur. Stand., Vol. 63A, No. 3, 275-8 (Nov.-Dec., 1959).

The present state of the analysis of this spectrum is discussed briefly. Even and odd levels are listed. The low even levels form terms arising from the configurations 6d^{2}7s^2 and 6d^{3}7s. The Th I standard wavelengths that fit into the known level arrays are presented.

MOLECULES

539.1

7734 RELAXATION SOLUTION OF THE THOMAS—FERMI ATOMIC EQUATION.

J.R.Townsend and G.S.Handler.

J. chem. Phys., Vol. 31, No. 6, 1689-90 (Dec., 1959).

As a test of the numerical methods to be applied to molecular problems, the atomic T-F equation was integrated by the relaxation method, with a two-parameter mesh transformation $y = 1/(bx^q + 1)$, for four different meshes of 25 to 49 points. Results give good agreement with the direct numerical solution in Abstr. 572 (1956).

J.Hawgoo

539.19

7735 THE INTRA-MOLECULAR FLEXIBILITY OF AMINES. H.Kramer.

Z.Naturforsch., Vol. 15a, No. 1, 66-73 (Jan., 1960). In German.

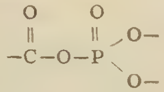
Dielectric absorption studies, using radiation varying in wavelength from the metre to the millimetre range, were carried out for primary and secondary aliphatic and aromatic amines. The experimental data were analysed in terms of contributions from the over-all rotation of the molecules as well as from the individual flexibility of the NH_2 groups. W.J.Orville-Thomas

539.19

7736 A QUANTUM MECHANICAL CALCULATION OF THE ELECTRON DISTRIBUTION IN CARBOXYL-PHOSPHATE AND SOME RELATED MOLECULES. B.Grabe.

Ark. Fys., Vol. 15, Paper 17, 207-24 (1959).

The electron distribution in the



$$-\overset{\overset{O}{\|}}{C}-O-\overset{\overset{O}{\|}}{P}\begin{matrix}\diagup O-\\ \diagdown O-\end{matrix}$$

group of the carboxyl-phosphate molecule has been calculated by a semi-empirical method. Six electrons are taken into consideration explicitly, viz. two π-electrons of the C = O double bond, the lone pair at the bridge O-atom and two electrons of the phosphoryl group, corresponding to the usual π-approximation. For comparison, the electron distribution in the carboxyl ion, in the phosphate ion and in polyphosphates of the same type as adenosine diphosphate and triphosphate have been calculated. It appears from the calculations that the charges due to the "π-electrons" on the C- and P-atoms respectively are approximately the same for all the molecules considered. The charges on the bridge O-atoms in carboxyl-phosphate and in the polyphosphates are on the other hand very different from the charges on the other O-atoms of the same group and also from the charges on the O-atoms of the carboxyl and phosphate ions. The possibility of explaining some experimental data, by means of the results obtained, concerning energy transfer in the living cell is discussed.

539.19

7737 CATALYTIC EFFECTS IN THE DISSOCIATION OF OXYGEN IN MICROWAVE DISCHARGES.

F.Kaufman and J.R.Kelso.

J. chem. Phys., Vol. 32, No. 1, 301-2 (Jan., 1960).

Oxygen dissociation is powerfully catalysed by N_2, NO, N_2O and H_2 but the presence of He, A, or CO_2 has no effect. It is felt that any explanation based on surface activity is unsatisfactory and some possible chain reactions are discussed. G.I.W.Llewelyn

539.19

7738 SELF-DISSOCIATION AND PROTONIC CHARGE TRANSPORT IN WATER AND ICE.

M.Eigen and L.De Maeyer.

Proc. Roy. Soc. A, Vol. 247, 505-32 (Oct. 21, 1958).

A comprehensive survey on experimental techniques, results and theoretical interpertations concerning the self-dissociation and protonic charge transport in water and ice is given. Direct measurements of individual properties of "excess" and "defect" protons in ice (mobilities, concentrations, reaction rates) are presented. The proton transport in hydrogen-bonded media is completely different from normal ionic migration and corresponds more to electronic transport processes in semiconductors. Generally the proton transport through hydrogen bonds includes two processes: (1) the formation (or rearrangement) of (H-bond) structure with orientation, favourable for a proton transition; and (2) the charge transfer within the H bond. The first step is rate determining in water, whereas the second one is decisive for the charge transport in ice. The requirements for a theoretical treatment therefore are (1) for water: a theory of "structural diffusion" of the H-bonded hydration complex of H_3O^+, and (2) for ice: a (quantum-mechanical) theory of the protonic motion within the potential well of the H bond. The mechanism of structural diffusion provides an explanation of the anomalous H_3O^+ and OH^- mobility and their recombination rate in water. Arguments demonstrating the analogy between protonic and electronic charge transport are given.

539.19 : 537.56

7739 THE IONIZATION AND DISSOCIATION OF SOME HALOGEN MOLECULES BY ELECTRON IMPACT.

D.C.Frost and C.A.McDowell.

Canad. J. Chem., Vol. 38, No. 3, 407-20 (March, 1960).

The ionization and dissociation of chlorine, bromine, iodine, iodine monochloride, and iodine monobromide by electron impact were studied in a mass spectrometer which uses a monoenergetic electron source. Many ionization potentials have been observed for these molecules which, of course, refer to the formation of the parent molecular ions in different excited states. These experimental results are discussed in terms of simple molecular orbital theories of the electronic structures of the different halogen molecules. Electron-induced dissociative ionization processes for the different substances have also been studied. Where possible, appearance potentials of both the positive and negative ions have been determined. These results have been used to construct potential energy diagrams illustrating the origin of some of the negative ion and dissociation processes observed.

539.19

7740 A PERTURBATION CALCULATION OF OSCILLATOR STRENGTHS OF HeH^{2+}. A.Dalgarno and A.L.Stewart.

Proc. Roy. Soc. A, Vol. 254, 570-4 (March 8, 1960).

A perturbation calculation, valid in the limit of large separations of the oscillator strengths of the $1s\sigma$-$2p\sigma$ and $1s\sigma$-$2p\pi$ transitions of HeH^{2+} was carried out. The accuracy is high over a wide range of nuclear separations for the direct transition $1s\sigma$-$2p\pi$, but the methods fail for the charge-transfer transition $1s\sigma$-$2p\sigma$ because of the importance of configuration interaction in the description of the $2p\sigma$ state.

539.19

7741 CALCULATION OF LINEAR COMBINATIONS OF SPHERICAL HARMONICS FORMING BASES OF IRREDUCIBLE REPRESENTATIONS OF THE GROUPS O_h AND T_d.

J.Moret-Bailly.

C.R. Acad. Sci. (Paris), Vol. 250, No. 6, 990-1 (Feb. 8, 1960). In French.

These linear combinations can be found by constructing certain sets of complex polynomials which transform in the same way as the spherical harmonics. J.Hawgood

539.19

7742 ON THE FORM OF THE SECULAR EQUATION GIVING THE VIBRATION-ROTATION LEVELS OF A MOLECULE WITH AXIAL SYMMETRY. G.Amat.

C.R.Acad. Sci. (Paris), Vol. 250, No. 8, 1439-40 (Feb. 22, 1960). In French.

It is shown that symmetry considerations can predict which matrix elements are non-zero. J.Hawgood

539.19

7743 VIBRATIONAL POTENTIAL FUNCTIONS FOR SOME MOLECULES AND FREE RADICALS.

A.van de Vorst and J.Duchesne.

Bull. Acad. Roy. Belgique Cl. Sci., Vol. 55, No. 5, 686-713 (1959). In French.

Frequency—force constant relations are derived for tri- and tetra-atomic molecules of symmetries C_∞, C_s, and C_{2v}. With these relations and the fundamental frequencies observed for CH_2O in the ground and excited states, and those for certain excited states of the free radicals HCO and HNO, force constants are determined and discussed in terms of the electronic structures of the bonds.

W.J.Orville-Thomas

539.19

7744 CENTRIFUGAL DISTORTION IN SYMMETRIC TOP MOLECULES. M.W.Long.

J. chem. Phys., Vol. 32, No. 3, 948 (March, 1960).

An attempt is made to explain the observed negative values for the distortion coefficients in the molecules $CFCl_3$ and $CHCl_3$.

R.A.Ballinger

539.19

7745 OUT-OF-PLANE VIBRATIONS OF MOLECULES CONTAINING PLANAR XY_4 RINGS. I. THE NORMAL VIBRATION PROBLEM. J.E.Stewart.

J. chem. Phys., Vol. 32, No. 4, 1165-7 (April, 1960).

The F and G matrix elements for out-of-plane vibrations of molecules containing planar, five-membered heterocyclic rings of the type XY_4 are derived under the assumption that substituents on the ring can be treated as point masses.

539.19 : 533.7

TRANSITIONAL-VIBRATIONAL ENERGY TRANSFER IN DIATOMIC MOLECULES. See Abstr. 6832

539.19

7746 VIBRATIONAL CHARACTERISTICS OF QUASI-HARMONIC SYSTEMS RELATED TO DIATOMIC MOLECULES.

N.B.Slater.

Proc. Leeds Phil. Lit. Soc., Vol. 8, Pt 3, 93-108 (Jan., 1959).

Solutions are given for the motion of a particle (or the relative motion of two particles, as in a diatomic molecule) under various potentials, including those of Morse, and Poeschl and Teller. The classical periodic motions are transformable, in all but one of the cases considered, into simple harmonic motion, so that the average behaviour in higher quantum states can easily be estimated. The general quasi-harmonic potential (defined as having periodic motions transformable into simple harmonic motion) is found to include the Morse and Poeschl—Teller potentials and also a "humper" potential. The quantum levels of quasi-harmonic potentials are quadratic in the quantum number, so that the classical frequency at a given level corresponds exactly to the quantum energy difference of the adjacent half levels. The Rosen—Morse potential is not quasi-harmonic, but its classical frequency is related to its energy levels in approximately the same way.

539.19

7747 COMPUTER PROGRAM FOR CENTRIFUGAL DISTORTION IN ASYMMETRIC TOP ROTATIONAL SPECTRA.

G.Erlandsson.

Ark. Fys., Vol. 16, Paper 15, 181-4 (1959).

The electronic computer Besk has previously been applied to the analysis of asymmetric top rotational spectra in the rigid case (Abstr. 6017 of 1955; 1425 of 1956). In the present work, the use of Besk has been extended to a first order treatment of centrifugal distortion in such spectra. The programme has been tried on a group of Q-branch lines in the spectrum of formaldehyde and has given a good representation of observed distortions. The results obtained are consistent with results obtained previously by other methods.

539.19

7748 INDUCED INFRARED ABSORPTION IN GASES. CALCULATION OF THE TERNARY ABSORPTION COEFFICIENTS OF SYMMETRICAL DIATOMIC MOLECULES.

J. van Kranendonk.

Physica, Vol. 25, No. 5, 337-42 (May, 1959).

The theory of induced infrared absorption developed previously is applied to the calculation of the ternary absorption coefficient of the vibrational band of symmetrical diatomic molecules. The ternary absorption coefficient of the fundamental vibrational band of hydrogen is calculated with the help of the exp 4 model for the induced pair dipole moment. Because of interference effects occurring in the absorption by triples of molecules, the ternary absorption coefficient is roughly an order of magnitude smaller than in the absence of such interference effects. This result is in accord with the experimental findings that for densities up to 100 amagat no deviation of the integrated absorption coefficient from a purely quadratic density dependence can be detected.

539.19

7749 THE ABSORPTION INTENSITY OF SIMULTANEOUS VIBRATIONAL TRANSITIONS IN GAS MIXTURES.

J.P.Colpa and J.A.A.Ketelaar.

Physica, Vol. 24, No. 12, 1035-44 (Dec., 1958).

A formula is derived for the intensity of those simultaneous transitions in gas mixtures in which take part an i.r. active vibrational transition of one molecule and a Raman-active vibrational transition of another molecule. This formula was applied to the simultaneous transition observed in mixtures of carbon dioxide and hydrogen at 6510 cm^{-1}. Using two different reported values for the derivative of the polarizability of hydrogen with respect to the intermolecular distance, integrated binary absorption coefficient values were found of $0.63 \times 10^{-3}\ \mathrm{A}^{-2}\mathrm{cm}^{-2}$ and $1.2 \times 10^{-3}\ \mathrm{A}^{-2}\mathrm{cm}^{-2}$. The experimental value is $0.88 \times 10^{-3}\ \mathrm{A}^{-2}\mathrm{cm}^{-2}$.

539.19

7750 VIBRATIONAL BAND INTENSITIES AND STRUCTURAL FACTORS.

P.J.Krueger and H.W.Thompson.

Proc. Roy. Soc. A, Vol. 250, 22-38 (Feb. 24, 1959).

Earlier work on the effect of ring substituents on the frequencies and intensity of vibrations of a functional group attached to an aromatic ring has been extended. New data have been obtained for anilines, benzonitriles, phenols and other classes, including many ortho-substituted compounds. The results have been interpreted in terms of quantitative estimates made by other methods for the inductive and resonance effects of different substituents. There is a regular trend for each functional group between band frequency and Hammett σ factor of the substituent. Also, the plot of log (band intensity) against σ is essentially linear over a wide range. Ortho-substituents fall regularly into these relations if the Taft σ values for ortho-substituent are used, and if no internal hydrogen bonding occurs. The data for meta- and para-derivatives can be analysed i greater detail using the measures for inductive and resonance effec of different groups obtained by Taft from kinetic data. The results suggest the circumstances under which substituents may be expecte to cause large variations of band intensity. Measurements have be made in carbon tetrachloride and chloroform and new data have bee obtained about the effect of solvent medium upon spectral characteristics The possibility of correlating spectral data in aliphatic seri with electronic influences of substituents groups has been considere in a preliminary way.

539.1

7751 THE INFLUENCE OF VIBRATION—ROTATION INTERACTION ON LINE INTENSITIES IN THE PERPENDICULAR AND PARALLEL INFRARED BANDS OF THE LINEAR SYMMETRIC X—Y—X MOLECULE.

J.H.Waggoner, Jr and W.H.Shaffer.

J. molecular Spectrosc., Vol. 4, No. 3, 224-40 (March, 1959).

Vibration—rotational interaction manifests itself in the Hamiltonian of the linear symmetric X—Y—X molecule through the terms

$$q_1(P^2 - \Pi_z^2)$$

and

$$(\Pi \cdot P + P \cdot \Pi - 2P_z^2),$$

where q_1 is the normal coordinate for the breathing mode, P is the total angular momentum operator, Π is the internal vibrational angular momentum operator, and the z coordinate axis lies along the equilibrium internuclear axis. Corrections to the dipole moment matrix elements due to these terms are obtained; the contact transformation method of Hanson et al (Abstr. 7734 of 1957) is used to simplify the calculations. Account is taken of the fact that the factor $(2\pi)^{-1/2}e^{il\xi}$, where ξ is the angle involved in the two-fold degenerate oscillation, is shared by ψ_0 (vibration) and ψ_0 (rotation) in the zero-order wave functions. The resulting intensity expressions indicate, just as the results of Herman and Wallis (Abstr. 5317, 4836 of 1955; 2469 of 1957) for the diatomic molecule, that vibration—rotation interaction gives rise to band asymmetry.

539.1

7752 PERTURBATION AT LOW TEMPERATURE OF HBr IN SOLUTION IN ARGON, NITROGEN AND OXYGEN IN GAS LIQUID AND SOLID STATE.

Hai Vu and G.C.Turrell.

C.R. Acad. Sci. (Paris), Vol. 249, No. 25, 2758-60 (Dec. 21, 1959). In French.

A study of the Q branch of HBr at 2559 cm^{-1}, perturbed by A,N_2 and O_2 in the gas, liquid or solid state according to temperature and pressure. Results are compared with those obtained for the Q bran of HCl under similar conditions.

R.C.Seymou

539.1

7753 STUDY OF THE ROTATIONAL TEMPERATURE OF TH $^1\Sigma$ - $^1\Pi$ ANGSTRÖM BANDS OF CARBON MONOXIDE EMITTED FROM A HOLLOW CATHODE.

S.Weniger.

C.R. Acad. Sci. (Paris), Vol. 250, No. 11, 2001-3 (March 14, 1960). In French.

Measurements were made with the hollow cathode at room and at liquid-nitrogen temperatures. In the plots of $\log_e$ (observed intensity/rotational-intensity factor) against J' $(J' + 1)$, points for low rotational quantum number J' do not come on the straight line.

A.G.Gaydo

539.19

7754 ROTATIONAL ANALYSIS OF THE $C^2\Pi$ -$X^2\Sigma^+$ SYSTEM OF CaCl.

E.Morgan and R.F.Barrow.

Nature (London), Vol. 185, 754-5 (March 12, 1960).

Rotational analyses of the 0-0 band and of the shorter waveleng sub-bands of the 1-0 and 0-1 bands have been made. The value of r_e'' is 2.439 A, a little shorter than the Ca-Cl distance in gaseous $CaCl_2$, 2.51 ± 0.03 A.

R.F.Barro

539.19 : 523.1

AN EXTENSION OF THE $^1\Pi$—$^1\Sigma$ SYSTEM OF CH^+.

See Abstr. 6551

539.19

7755 FUNDAMENTAL VIBRATION FREQUENCIES OF D_2O^{18} VAPOR.

S.Pinchas, M.Halmann and B.P.Stoicheff.

J. chem. Phys., Vol. 31, No. 6, 1692-3 (Dec., 1959).

The fundamental frequencies of D_2O^{18} vapour have been obtained $\nu_1 = 2565.8 \pm 2\ cm^{-1}$, $\nu_2 = 1169.3 \pm 2\ cm^{-1}$, $\nu_3 = 2764 \pm 2\ cm^{-1}$, in good agreement with calculated values. R.C.Seymour

539.19

7756 VIBRATION—ROTATION SPECTRA OF HCN.

D.H.Rank, G.Skorinko, D.P.Eastman and T.A.Wiggins.

J. Opt. Soc. Amer., Vol. 50, No. 5, 421-32 (May, 1960).

An analysis of the spectrum of the linear unsymmetric molecule $HC^{12}N$ was made permitting the determination of the 21 constants necessary for predicting the vibrational frequencies and the 10 constants necessary for predicting the B value for the various vibrational states. To determine these constants new measurements were made on numerous bands in the region of 1-3 μ employing a 5 m vacuum spectrograph. Several instances of Fermi resonance were detected and analysed. Except for a few bands where additional resonances may be present, the vibrational constants predict the measured values for the band origins of 44 bands within an amount not much greater than the expected experimental error. The rotational constants also predict the B value within the experimental error for 24 bands where data are available. Bands of $HC^{13}N$ and $DC^{12}N$ were also measured to determine the α values for calculation of the equilibrium moment of inertia. The 101-000 and 11^11-01^10 bands were used for all three isotopic forms of HCN to determine the B_e values in a parallel fashion. From these values the bond length C—H = 1.06593 ± 0.00010 A and C—N = 1.15313 ± 0.00002 A were determined. In five different cases in $HC^{12}N$ it was possible to apply the Ritz combination principle to determine the frequency of the 01^10 state. By using this value and the rotational constants it was possible to calculate the frequencies of lines in the 01^10-000 band. The principle is also applied to $HC^{13}N$ and $DC^{12}N$.

539.19

7757 ON THE ABSORPTION SPECTRUM OF ICl. I.

E.Hulthén, N.Johansson and U.Pilsäter.

Ark. Fys., Vol. 14, Paper 3, 31-48 (1958).

The $^3\Pi_1 \leftarrow {}^1\Sigma$ vibration—rotation bands situated in the visible and near infrared have been studied under extremely high resolution for the following transitions:

ICl^{35} v'' = 0,1,2, v' = 10-18, J = 1-90;
ICl^{37} v'' = 0, v' = 16-18, J = 1-60.

Tables are given of the term-values of $^1\Sigma$ based on the agreement between the observed wave-number differences of the R and P branches and those calculated from microwave data. Further tables of the term-values of $^3\Pi_1$ and of the vibrational and rotational constants of both states are then computed. The Morse function is shown to agree well with observations on the $^1\Sigma$ ground-state and finally a value for the mass-ratio of the chlorine isotopes is obtained from the vibrational effects. The unusual spectrographic equipment and its calibration is discussed in considerable detail, the use of an immersion grating yielding a dispersion of 0.7 cm/A with a resolving power of approximately 10^6. P.A.Young

539.19

7758 ON THE MECHANISM OF THE LEWIS—RAYLEIGH NITROGEN AFTERGLOW.

K.D.Bayes and G.B Kistiakowsky.

J. chem. Phys., Vol. 32, No. 4, 992-1000 (April, 1960).

The relative intensities in the nitrogen afterglow, from 5000 to 11 000 A, were measured in pure nitrogen and after addition of several foreign gases. Most of the bands in the recently discovered Y—B $^3\Pi_g$ system are overlapped by B $^3\Pi_g$—A $^3\Sigma_u^+$ bands but intensity assignments have been made. Changes in relative intensities accompanying changes in external conditions show that the bands can be classified into five groups of different kinetic origins. The vibrational levels of the B $^3\Pi_g$ and Y states just below D_e, the energy of two separated ground state nitrogen atoms, are not populated. At low temperature the highest populated levels of the B $^3\Pi_g$ and Y states tend to a limit about 850 cm^{-1} below D_e. It is suggested that this is approximately equal to the dissociation energy of the $^5\Sigma_g^+$ state of the nitrogen molecule. Some of the emission from the low vibrational levels of the B $^3\Pi_g$ state is associated with the radiation cascade Y → B $^3\Pi_g$ → A $^3\Sigma_u^+$, but the rest has a different kinetic origin. The emission from B $^3\Pi_g$ (v = 7,6,5) is probably the second step in the cascade $^3\Delta_u$ → B $^3\Pi_g$ → A $^3\Sigma_u^+$. Foreign gases modify the vibrational population distribution of the upper levels of the B $^3\Pi_g$ state, each in its characteristic fashion. Some gases quench the emission from the lowest vibrational levels of B $^3\Pi_g$ more effectively than the rest of the spectrum. The quenching of the emission from the higher levels depends on the pressure of nitrogen. A mechanism accounting for most of the afterglow emission is discussed.

539.19

7759 ROTATIONAL ANALYSIS OF THE B—X BAND SYSTEM OF THE SbO MOLECULE.

S.V.J.Lakshman.

Z. Phys., Vol. 158, No. 4, 386-91 (1960).

Rotational analyses of the two 0—0 bands of the $B^2\Sigma$—$X^2\Pi_{reg}$ system were carried out for the first time from spectrograms taken in the second order of a 21 ft concave grating spectrograph having a dispersion of 1.25 A/mm. The rotational constants of the v = 0 vibrational levels of the upper and lower states, and of the coupling constant A_0 of the lower $^2\Pi_{reg}$ state, were deduced. These values are $v_{00} = 25\,334.93\ cm^{-1}$, $A_0 = 2276\ cm^{-1}$, $B_0' = 0.3190\ cm^{-1}$, $r_0' = 1.933$ A, $B_0'' = 0.3490\ cm^{-1}$, $r_0'' = 1.848$ A.

539.19

7760 INFRARED SPECTRA OF ALKYLDIBORANES. I. MONOMETHYLDIBORANES.

W.J.Lehmann, C.O.Wilson, Jr and I.Shapiro.

J. chem. Phys., Vol. 32, No. 4, 1088-93 (April, 1960).

The infrared spectra of five isotopic derivatives of monomethyldiborane ($CH_3B_2^{10}H_5$, $CH_3B_2H_5$, $CH_3B_2D_5$, $CD_3B_2H_5$, and $CD_3B_2D_5$) are analysed and frequency assignments are made through correlation with trimethylborane and terminally substituted B_2H_5D and B_2D_5H.

539.19

7761 SOME VIBRATIONAL—ROTATIONAL BANDS OF DEUTERATED METHANES.

H.C.Allen, Jr and E.K.Plyler.

J. Res. Nat. Bur. Stand., Vol. 63A, No. 2, 145-52 (Sept.-Oct., 1959).

A parallel band at 2200 cm^{-1} and a perpendicular band at 2780 cm^{-1} of CH_3D were observed under high resolution and analysed. The analysis of the perpendicular band revealed the presence of l-type doubling in the doubly degenerate excited state. From the analysis of the parallel band it is found that $B_0 = 3.880\ cm^{-1}$. A hybrid band of CD_3H was observed near 2600 cm^{-1}. Both active components, A and E, are observed and analysed. The ground state B_0 value found from this analysis is in good agreement with previous determinations.

539.19

7762 ASSIGNMENT OF THE VINYL FLUORIDE WAGGING MODES.

J.R.Scherer and W.J.Potts.

J. chem. Phys., Vol. 31, No. 1, 1691-2 (Dec., 1959).

Recently obtained spectra of the deutero-isotopes of vinyl fluoride suggest by analogy with the chloride and bromide, an out-of-plane fundamental at 940 cm^{-1}. A normal coordinate analysis now shows that this disputed twisting frequency in CH_2CHF is at 931 cm^{-1}, that is, so close to the 929 cm^{-1} in-plane frequency that it would not be detected in the gas phase. R.C.Seymour

539.19

7763 THE RAMAN SPECTRUM OF GASEOUS OXYGEN.

A.Weber and E.A.McGinnis.

J. molecular Spectrosc., Vol. 4, No. 3, 195-200 (March, 1960).

The pure rotational and rotation—vibrational Raman spectra at 1 atm pressure were photographed under high dispersion in the first order of a 15 000 lines/in., 21 ft concave grating in a Wadsworth mounting. The molecular constants are: $\Delta\nu_0 = \Delta G_{1/2} = 1556.26$; $B_e = 1.4457$; $\alpha_e = 0.0158$; $D_0 = D_v = 5.6 \times 10^{-6}\ cm^{-1}$. These results are in good agreement with those obtained from the study of the electronic spectrum.

539.19

7764 THE EFFECT OF PRESSURE ON THE RAMAN SPECTRUM OF OXYGEN.

G.V.Mikhailov.

Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1570-4 (Dec., 1959).
In Russian.

The Raman spectrum of oxygen was studied at pressures between 7 and 125 atm at 27°C. Broadening of lines in the rotational band of O_2 is of a collision nature at these pressures, the effective collision broadening radius being $\rho_\omega = 4.43$ A. The parameters representing the width of the Raman rotational lines are identical with those of O_2 absorption in the microwave region. In distinction to the lines of the rotational band, the Q-branch of the vibrational transition of O_2 does not broaden with variation of the pressure. The observed width of the Q-branch is explained by splitting of the branch with respect to J due to interaction between vibrations and rotations.

539.19

7765 SOME RESULTS OF RESONANCE RAMAN SPECTROSCOPY.

W.Maier and F.Dörr.

Appl. Spectrosc., Vol. 14, No. 1, 1-3 (1960).

The intensity of scattered Raman radiation increases greatly as the exciting frequency approaches an absorption band of the molecule. This phenomenon, termed "Resonance Raman Effect", permits new spectroscopic applications. For instance, a red cyanine dye absorbing strongly at 542 mμ was successfully investigated, using the 5461 line of Hg for irradiation, at dye concentrations as low as 10^{-6} mole/litre. Shifts in absorption due to solvent or substituent effects show great influence upon line intensities, as demonstrated with p-nitroso-dimethyl-aniline. There is no evidence of $n \rightarrow \pi^*$ bands also causing the effect. According to theoretical aspects by Behringer, selection rules based on the Franck—Condon principle are valid. This makes for relatively simple resonance Raman spectra.

539.19

7766 ARGON--XENON BANDS.

H.M.Jongerius, J.L. van Koeveringe and H.J.Oskam.

Physica, Vol. 25, No. 5, 406-8 (May, 1959).

Bands appear in the spectrum from the cathode glow of a discharge in a mixture of argon and xenon which do not appear in the spectra from either of the pure gases. G.H.C.Freeman

539.19

7767 SOURCE OF GREEN BANDS FROM BORON-CONTAINING FLAMES.

W.E.Kaskan and R.C.Millikan.

J. chem. Phys., Vol. 32, No. 4, 1273-4 (April, 1960).

The strongest of the boron "fluctuation" bands at 5470 A was studied in absorption as a function of flame height, temperature and composition. Simultaneous measurement of absorption of the infrared band of HBO_2 and of OH have been made. Results are inconsistent with B_2O_3 being the emitter of the "fluctuation" bands; BO_2 is suggested as probable emitter. A.G.Gaydon

539.19

7768 THEORY OF THE MAGNETIC AND SPECTROSCOPIC PROPERTIES OF NEPTUNIUM HEXAFLUORIDE.

J.C.Eisenstein and M.H.L.Pryce.

Proc. Roy. Soc. A, Vol. 255, 181-96 (April 5, 1960).

The magnetic properties and the optical absorption spectrum of NpF_6 are interpreted on the basis of an appropriate model for the molecule. The theory, in its simplest form, is not in perfect accord with all the available data. Consequently, various physical effects such as covalence, vibronic interactions, the Coriolis force on the unpaired electron, and the Jahn—Teller effect, which might affect the agreement of theory and experiment are discussed in a qualitative or semi-quantitative way. It is pointed out that the g value may vary with temperature so that one must be cautious when comparing the paramagnetic resonance and susceptibility data with theoretical predictions. The Coriolis interaction between the electron (effective) spin and the molecular rotation is sufficiently large to modify the magnetic resonance frequency by an appreciable amount when rotation is free, which is very probably why no paramagnetic resonance has been observed in gaseous NpF_6. Experiments which would help to clarify the interpretation are suggested.

539.19

7769 ROLE OF ARGON IN THE DEVELOPMENT OF SOME BAND SYSTEMS OF NITROGEN.

N.R.Tawde and D.D.Desai.

Proc. Nat. Inst. Sci. India A, Vol. 23, No. 2, 119-29 (1957).

The spectrum of nitrogen in the discharge through air is characteristically different from that in pure nitrogen. The role of argon content of air in causing this characteristic difference has been studied systematically by observing the spectra of graded mixtures of pure nitrogen with argon. These are compared with the spectra of pure nitrogen and of atmospheric air. The experimental method consisted in measuring quantitatively the intensity distributions in 1(P) and 2(P) systems relative to each other and also among the vibrational bands in each of them individually. Critical analysis of the effect of oxygen admixture, as studied earlier by Tawde and Korgaokar (1954) as against the effect of admixture of argon has been made in the light of the results and conclusions arrived at from this investigation. It appears that the two gases play a similar role but oxygen seems to exert a more predominant influence. In other directions, the way in which argon would cause the suppression of one system with respect to the other has been examined in terms of the possible energy exchanges between argon and nitrogen in the discharge mixtures. Further, the intensity distributions among vibrational levels of the two systems individually have given some peculiar features of selective enhancement, which have been critica discussed.

539.1

7770 EMISSION SPECTRA OF N_2, O_2, AND NO MOLECULES TRAPPED IN SOLID MATRICES.

H.P.Broida and M.Peyron.

J. chem. Phys., Vol. 32, No. 4, 1068-71 (April, 1960).

Molecular systems were observed in emission in solid product from a gas discharge trapped at liquid helium temperature. Previous tentative molecular assignments have been checked with the help of isotopic substitutions of oxygen and nitrogen. The Herzberg system (A bands) of oxygen ($A^3\Sigma_u^+ - X^3\Sigma_g^-$) is analysed and the molecular constants are derived for a molecule trapped in a nitrogen matrix. Another system (M bands) is attributed to the NO molecule ($^4\Pi - X^2\Pi$).

539.1

7771 THE MICROWAVE SPECTRUM AND PLANARITY OF NITROBENZENE.

K.E.Reinert.

Z. Naturforsch, Vol. 15a, No. 1, 85-6 (Jan., 1960). In German.

The microwave spectrum of nitrobenzene is reported and frequency values assigned to certain J = 3 → 4, 7 → 8, 8 → 9, and 9 → 10 transitions. The spectrum is interpreted in terms of a rigid rotator, i.e. centrifugal distortion is ignored, and values of $I^0 = 126$ $I_b^0 = 393.7_8$, $I_2^0 = 518.8_7$ (atomic mass units × A^2) derived. The sma value (-0.9) obtained for the quantum defect is taken by the author t indicate an all-planar structure for $C_6H_5.NO_2$.

W.J.Orville-Thoma

539.19

7772 ANOMALOUS FARADAY DISPERSION OF O_2.

J.T.Hougen.

J. chem. Phys., Vol. 32, No. 4, 1122-5 (April, 1960).

The Verdet constant O_2, in contrast to that of other colourless molecules, is not approximately proportional to ν^2 in the visible, near ultraviolet, and near infrared spectral regions. It is shown that the inability of early theoretical treatments to explain the observed frequency dependence can be overcome by including in the Hamiltonian for the problem the interaction of the spin magnetic moment of the O_2 molecule with the magnetic field of the light wave being propagated through the sample cell. This corresponds to considering magnetic dipole transitions as well as electric dipole transitions in the absorption spectrum. An expression is obtained which fits the oxygen data to 1%.

539.19

7773 THE BAND SPECTRUM OF SbO: A NEW DOUBLET SYSTEM.

S.V.J.Lakshman.

Z. Phys., Vol. 158, No. 3, 367-73 (1960).

The band spectrum of SbO was excited in a heavy current discharge from a 2000 V d.c. generator. A new doublet system of bands occurring in the region from 2800 to 3600 A arising from a transitio of the type $^2\Delta_r - ^2\Pi_r$ was identified. The lower $^2\Pi_r$ state is found to be common to those of the three band systems reported earlier, which is in all probability the ground state of the SbO molecule. The band heads of the high frequency and low frequency components coul be represented by the following quantum formulae :

$^2\Delta_{\frac{3}{2}} - ^2\Pi_{\frac{1}{2}}$:

$$\nu = 29754.6 + 570.6(v' + \tfrac{1}{2}) - 3.52(v' + \tfrac{1}{2})^2 - 820.5(v'' + \tfrac{1}{2}) + \\ + 4.62(v'' + \tfrac{1}{2})^2$$

$^2\Delta_{\frac{5}{2}} - ^2\Pi_{\frac{3}{2}}$:

$$\nu = 28044.8 + 568.1(v' + \tfrac{1}{2}) - 3.28(v' + \tfrac{1}{2})^2 - 819.2(v'' + \tfrac{1}{2}) + \\ + 4.62(v'' + \tfrac{1}{2})^2$$

The possibility of the existence of another brief system is indicated.

539.1

7774 ELECTRONIC STRUCTURE OF THE FIRST ROW HYDRIDES BH, CH, NH, OH AND FH. I. GROUND STAT

A.C.Hurley.

Proc. Roy. Soc.A, Vol. 248, 119-35 (Oct. 28, 1958).

Some recent calculations by the self-consistent field molecular orbital method are generalized to allow for electron correlation.

Correlations between the motions of the valence electrons are introduced explicitly by means of configuration interaction, whilst the effects of intra-atomic electron correlation are estimated semi-empirically. Both forms of correlation, but especially the latter, are found to have a profound effect on the calculated properties of the hydrides. The total electronic energies obtained in the final calculations fall consistently above the experimental values by an almost constant amount (0.5 to 0.7 eV). The wave functions and dipole moments of the molecules are analysed in the frameworks of both the valence-bond and molecular orbital theories.

539.19

7775 THE ELECTRONIC STRUCTURE OF THE FIRST ROW HYDRIDES BH, CH, NH, OH AND FH. II. EXCITED STATES. A.C.Hurley.
Proc. Roy. Soc. A, Vol. 249, 402-13 (Jan. 13, 1959).

For Pt I, see preceding abstract.. Previous calculations on the ground states of the hydrides are extended to include the stable excited states. The initial orbital calculations predict vertical excitation energies which differ from the experimental values by as much as 2 eV. However, when allowance is made for the effects of atomic electron correlation all errors in the calculated excitation energies become less than 0.2 eV. The locations of excited states of different multiplicities from those of the ground states are predicted to within this accuracy. The oscillator strengths of allowed transitions from the ground states are calculated using both the dipole-length and dipole-velocity formulae. The dipole-length values are in fair agreement with the only experimental value available (for OH $^2\Pi \rightarrow {}^2\Sigma^+$), whereas the dipole-velocity values are much too large. Possible improvements in the accuracy of the calculations are discussed.

539.19

7776 FRANCK—CONDON FACTORS AND r-CENTROIDS FOR SOME BANDS OF THE CO FOURTH POSITIVE ($A^1\Pi - X^1\Sigma$) BAND SYSTEM.
W.R.Jarmain, R.Ebisuzaki and R.W.Nicholls.
Canad. J. Phys., Vol. 38, No. 3, 510-13 (March, 1960).

The array for the CO fourth band-system is presented together with band-head wavelengths and r-centroids.

W.J.Orville-Thomas

539.19

7777 EXPERIMENTAL OSCILLATOR STRENGTH OF THE COMET-TAIL SYSTEM OF CO^+.
R.G.Bennett and E.W.Dalby.
J. chem. Phys., Vol. 32, No. 4, 1111-13 (April, 1960).

The radiative lifetimes (τ_V') of the upper electronic state of the comet-tail bands of CO^+ were measured. There is an appreciable variation (about 50%) of τ_V' with v', the upper electronic state vibrational quantum number. By using an average $\tau = (2.6)10^{-6}$ sec, and an average frequency corresponding to 4200 A an oscillator strength $f = (2.2 \pm 0.5)10^{-3}$ is calculated. The uncertainty arises largely because of the observed lifetime variation with v'

539.19

7778 ELECTRONIC STRUCTURE OF CARBON MONOXIDE. H.Brion and C.Moser.
J. chem. Phys., Vol. 32, No. 4, 1197-9 (April, 1960).

The LCAO—MO SCF orbitals for carbon monoxide are calculated with 1s, 2s, and 2p Slater atomic functions, using best atom (Roothaan) exponents. All atomic integrals have been calculated. While all the orbitals are orthogonal, the inner shells have been given a fixed form. The calculated binding energy (using these SCF orbitals for the molecular energy and the same atomic functions for atomic energy) is about 40% of that observed. A limited configuration interaction calculations gives about 55% of the observed binding energy. Both the single determinant and the CI wave-function predict a dipole moment which is in agreement with the observed sign C^-O^+, but the error in magnitude is rather large. The atomic populations suggest the sign of the dipole moment to be C^+O^-, in agreement with Malone's rule. The ionization energies have been calculated and the agreement with experiment is very satisfactory. Some of the observed lower electronic transitions can be understood by using single configurations constructed from the SCF orbitals, but, before a more complete analysis of the spectrum can be attemped, it may be necessary to introduce atomic functions from the M shell.

539.19

7779 HIGHER IONIZATION POTENTIALS OF LINEAR TRIATOMIC MOLECULES. I. CO_2.
Y.Tanaka, A.S.Jursa and F.J.LeBlanc.
J. chem. Phys., Vol. 32, No. 4, 1199-205 (April, 1960).

Four new Rydberg series, in addition to series already known were observed. One of them, which corresponds to the vibration series of Henning's series, converged to 18.23 eV, while the other three converged to a value of 19.38 eV and yielded an additional higher ionization potential. All the observed values were compared with the theoretically calculated values. Several new progressions of absorption bands were also observed.

539.19

7780 HIGHER IONIZATION POTENTIALS OF LINEAR TRIATOMIC MOLECULES. II. CS_2, COS, AND N_2O.
Y.Tanaka, A.S.Jursa and F.J.LeBlanc.
J. chem. Phys., Vol. 32, No. 4, 1205-14 (April, 1960).

Four ionization potentials for the CS_2 molecule, three for the COS, and three for the N_2O were determined by an analysis of Rydberg series of the respective molecules. The value for the first ionization potential of CS_2 agrees very well with the previous spectroscopically determined value; however, there was disagreement between the value for the first ionization potential of N_2O and that determined previously. Several progressions of absorption bands for each of the molecules were also observed.

539.19

7781 ON THE ABSORPTION SPECTRA OF CARBON DIOXIDE IN THE EXTREME ULTRAVIOLET.
N.Damany-Astoin, L.Sanson and M.C.Bonnelle.
C.R. Acad. Sci. (Paris) Vol. 250, No. 10, 1824-6 (March 7, 1960).
In French.

The absorption spectra between 160 and 1000A show several regions of continuous absorption. These can be attributed to the phenomena of ionization or photoionization. G.H.C.Freeman

539.19

7782 A THEORETICAL STUDY OF THE FLUORINE MOLECULE. J.Eve.
Proc. Roy. Soc.A, Vol. 246, 582-9 (Aug. 26, 1958).

A calculation, on the ground state of the F_2 molecule, has been carried out using no other approximations than those inherent in Roothaan's LCAO, SCF method. Approximations to the ionization potentials, certain of the excitation energies and the quadrupole moment were obtained from the LCAO, SCF solutions which also predicted an unstable molecule. For the purpose of comparison, the simplified LCAO, SCF equations resulting from neglecting inner- and outer-shell mixing were also solved. Finally, a limited configuration interaction calculation was carried out for the ground state of F_2 using the LCAO, SCF orbitals as a basis; a fairly good value for the binding energy resulted.

539.19

7783 THE $^2\Sigma_u^+$ STATE OF THE NEGATIVE MOLECULAR ION H_2^-. B.K.Gupta.
Physica, Vol. 25, No. 3, 190-4 (March, 1959).

The variational method is applied to the stable state of the negative ion of the hydrogen molecule. With the same effective charge for the electrons in H^- and in H, the values of the dissociation energy D_e and of the equilibrium internuclear distance R_e are 0.068 and 3.56, in atomic units, respectively as found by Eyring et al. (Abstr. 4119 of 1936). When two effective charges are used for H^- and another for H atom, the values obtained for D_e and R_e are 0.0125 and 5.76 respectively. In each case Moffitt's method (Abstr. 2866 of 1951) is also used to compute the same quantities, giving a large modification in the calculated D_e in the former and only slight change in the latter case.

539.19

7784 NEW INVESTIGATION OF THE H_2^+ MOLECULE-ION. R.Gáspár and B.Kotlay-Gyarmati.
Acta phys. Hungar., Vol. 7, No. 1, 175-9 (1957).

The ground state of the H_2^+ molecule-ion has been reinvestigated using shifted-centre eigenfunctions. The calculations showed that improved energy values are obtained where the shape of the chosen eigenfunction is originally in qualitative agreement with that of the exact eigenfunction. W.J.Orville-Thomas

539.19

7785 THE ADJUSTMENT BY CURVILINEAR INTEGRATION OF THE PARAMETERS OF A CHARACTERISTIC APPROXIMATE FUNCTION FOR THE H_2^+ ION MOLECULE.
F.Cabaret and J.Guy.
C. R. Acad. Sci. (Paris), Vol. 250, No. 8, 1441-3 (Feb. 22, 1960).
In French.

The H_2^+ ion molecule is treated as an example of the use of the trial function proposed by James the parameters of which are adjusted by the method proposed earlier (Abstr. 3454 of 1960). The theoretical estimate of the energy of the system is within 2% of the experimental value. W.J.Orville-Thomas

539.19

7786 A QUANTUM-MECHANICAL STUDY OF THE WATER MOLECULE. R.McWeeny and K.A.Ohno.

Proc. Roy. Soc. A, Vol. 255, 367-81 (April 16, 1960).

Non-empirical calculations of the electronic structure of the water molecule (treated as a full ten-electron system) are carried out for various types of wave-function. These include a 'bond orbital' function, a 'modified electron-pair' function, and various Roothaan-type self-consistent field (s.c.f.) functions. These approximations are refined by admitting interaction with up to twelve configurational functions of ground-state symmetry. Three bond angles are considered. The results show that the modified electron pair function, which has not hitherto been used in non-empirical calculations, provides the most satisfactory first approximation. This function is constructed from orthonormalized hybrid orbitals in order to overcome nonorthogonality difficulties; and the inclusion of configuration interaction in this particular basis is found to be simple, effective and physically meaningful. The concept of a 'core', comprising the oxygen inner shell and lone pairs and providing an effective field for the bond pairs, is found to be remarkably satisfactory. Provided the effective field is properly defined, it is then possible to treat the molecule formally as a four-electron system and to obtain, nevertheless, a total energy 0.3 eV better than that given by the best of the s.c.f. calculations. This suggests that the 'core approximation' is not a real obstacle to progress. The one-electron density matrices are calculated from the various wave functions and the corresponding dipole moments are evaluated.

539.19

7787 ELECTRONIC STRUCTURE OF LiH. V. A RADIALLY CORRELATED WAVE FUNCTION.

J.M.Robinson, J.D.Stuart and F.A.Matsen.

J. chem. Phys., Vol. 32, No. 4, 988-91 (April, 1960).

For Pt IV, see Abstr. 6192 (1959). The electronic energy and dipole moment of LiH have been calculated with valence-bond wave-functions into which some radial correlation has been introduced by assigning different orbitals to different electrons. The energy as calculated from the radially correlated functions is 0.76 eV lower than from the corresponding uncorrelated functions. The calculated dipole moment agrees well with that obtained in previous calculations. Moffitt's concept of "atoms in molecules" is applied to the correlated and uncorrelated functions.

539.19

7788 FORBIDDEN BAND SYSTEMS IN NITROGEN. III. THE Y $^3\Sigma_u^- \leftarrow X\ ^1\Sigma_g^+$ SYSTEM IN ABSORPTION.

P.G.Wilkinson.

J. chem. Phys., Vol. 32, No. 4, 1061-5 (April, 1960).

For Pt II, see Abstr. 12035 (1959). Four bands of the Y $^3\Sigma_u^- \leftarrow X\ ^1\Sigma_g^+$ system of nitrogen were observed in absorption in a path of 3.4 metre-atmospheres at 1518 A (0-0), 1484 A (1-0), 1453 A (2-0) and 1423 A (3-0). These bands consist of an unresolved Q branch (^QQ, ^QP, ^QR), and ^SR and ^0P branches. From a comparison of the experimental and calculated intensity distribution, it is shown that the upper state is $^3\Sigma_u^-$ rather than the alternative assignment of $^3\Delta_u$. It is further shown that the Y $^3\Sigma_u^-$ state is identical with the upper state of certain infrared bands recently found in the active nitrogen afterglow. Those bands are thereby identified as Y $^3\Sigma_u^- \rightarrow B\ ^3\Pi_g$. The upper state was designated "Y" by Kistiakowsky and Warneck. The constants of Y $^3\Sigma_u^-$ as obtained here are: $\omega_e = 1517.6_9$ cm^{-1}; $\omega_e x_e = 12.2_2$ cm^{-1}; $B_e = 1.472$ cm^{-1}; $\alpha_e = 0.016_1$ cm^{-1}; $T_{00} = 65850._6$ cm^{-1}; $r_e = 1.278_8$ A. The transition Y $^3\Sigma_u^- \leftarrow X\ ^1\Sigma_g^+$ receives intensity from perturbations of Y $^3\Sigma_u^-$ by $^1\Sigma_u^+$ and $^1\Pi_u$ states lying at higher energies.

539.19

7789 THE ELECTRONIC STRUCTURE OF THE NH_3^+ ION. J.C.Lorquet and H.Lefebvre-Brion.

J. Chim. phys., Vol. 57, No. 2, 85-9 (Feb., 1960). In French.

Theoretical studies have been carried out on the electronic structure of the NH_3^+ molecule-ion, using the LCAO-SCF method with configuration interaction being taken into account. The calculations were carried out for the two possible nuclear configurations and the results favoured the pyramidal model, as well as providing a theoretical explanation of the observed fact that the NH bonds ar strengthened in NH_3^+ as compared with NH_3. The ionization potential is in good agreement with the value obtained applying Koopma theorem. W.J.Orville-Thoma

539.

7790 β-BANDS OF THE UPPER VIBRATION STATE NO.7 IN THE SPECTRUM OF THE NO MOLECULE.

I.Deézsi.

Acta phys. Hungar., Vol. 11, No. 2, 155-60 (1960).

The bands were photographed in emission. They start from th vibrational level v' = 7 of the upper electronic state.

539.1

7791 CORRELATION BETWEEN SOLVENT-INDUCED FREQUENCY SHIFTS OF THE n—π* ULTRA-VIOLET ABSORPTION AND THE INFRARED C=O BAND OF KETONES.

M.Ito, K.Inuzuka and S.Imanishi.

J. chem. Phys., Vol. 31, No. 6, 1694 (Dec., 1959).

The linear relation shown to exist between the n—π* electronic absorption of certain ketones in various solvents and the shift of th i.r. C=O band, suggests that solute-solvent interaction in the excit state does not contribute to the blue shift of the former. The magnitude of this shift represents the stabilization energy of solute molecules in the ground state, arising from electrostatic interacti and/or hydrogen bonding with solvent molecules. R.C.Seymo

539.1

7792 IONIZATION POTENTIALS AND ELECTROSTATIC POLARIZATION. N.D.Coggeshall.

J. chem. Phys., Vol. 32, No. 4, 1265-6 (April, 1960).

Assuming that the difference of ionization potential, ΔE, betwe the two molecules differing by a methyl group is given by the electr static polarization energy of the methyl group it follows that $\Delta E \propto 1/r^4$ (r = distance of methyl group from the charge site). This implies an inverse fourth power relation between ΔE and n, the numbe of carbon atoms in the methyl substituted compound. In accordance with this prediction a plot of $(\Delta E)^{-1/4}$ against n for n-paraffins is found to be a straight line. Similar arguments for olefins lead to polarizability values for the methylene group in fair agreement wit those obtained from molar refractions. W.J.Orville-Thoma

539.1

7793 ON r-CENTROIDS OF MOLECULAR TRANSITIONS, EQUILIBRIUM INTERNUCLEAR SEPARATIONS AND OSCILLATOR TURNING POINTS. R.W.Nicholls and W.R.Jarmain.

Proc. Phys. Soc., Vol. 74, Pt 1, 133-6 (July, 1959).

The r-centroid concept is further extended by investigation of the relationship which exists between the r-centroids of the bands of a system, the equilibrium internuclear separations of the potentials involved, and the classical turning points of the oscillators in each of the vibrational levels of each potential (see Abstr. 6052 of 1956). R.W.Nicholl

539.1

7794 ONE-CENTER EXPANSION OF MOLECULAR WAVE FUNCTION. II. LOWER EXCITED STATES OF H_2.

S.Huzinaga.

Progr. theor. Phys., Vol. 17, No. 2, 162-8 (Feb., 1957).

For Pt I see Abstr. 8306 (1957). The method of one-centre expansion of molecular wave-function is applied to the calculation o electronic energies of lower excited levels, $^3\Sigma_g^+$, $^{3,1}\Sigma_u^+$ and $^{3,1}\Pi_u$ of H_2. Previously reported calculations for the ground $^1\Sigma_g^+$ level, giving the best value of the electronic dissociation energy as 3.8 eV were wrong. An alternative "best" value, 3.28 eV, is now given. As a whole, the results of the present calculations are reasonably good.

539.

7795 ONE-CENTER EXPANSION OF MOLECULAR WAVE FUNCTION. III. He—He REPULSIVE POTENTIAL.

S.Huzinaga.

Progr. theor. Phys., Vol. 17, No. 2, 169-76 (Feb., 1957).

For Pt II see preceding abstract. The repulsive potential between two normal He atoms is calculated by the method of one-centre expansion of molecular wave-function. The calculation is performed at smaller internuclear distances where the discrepancies between the experiment and the existing theoretical estimatio are very large. At an internuclear distance of 1.0 A the present calculation gives a better result than any of the calculations hither performed. The implication of the result is discussed.

539.19

7796 OBSERVATIONS OF THE THERMAL BEHAVIOR OF RADICALS IN GAMMA-IRRADIATED ICE.

.Siegel, L.H.Baum, S.Skolnik and J.M.Flournoy.
. chem. Phys., Vol. 32, No. 4, 1249-56 (April, 1960).

Ice was subjected to γ radiation at 77° K and the e.p.r. spectra of the radicals produced were examined as a function of temperature. The spectrum consisted essentially of a doublet centered at = 2.008 ± 0.002 and split by 40 gauss; the corresponding spectrum of irradiated D_2O consisted of a triplet with approximately 6 gauss between adjacent lines. The doublet decayed rapidly above 100° K leaving a residual broad line which was thermally stable until approximately 145° K. The main spectrum has been attributed to the OH radical and the residual line assigned to the HO_2 radical. The decay process of the OH radicals was shown to follow the rate law $d(OH)/dt = -k(OH)^{3/2}$ where $k = 8.5 \times 10^{12}$ exp-6000/RT (litre mole)$^{1/2}$ sec^{-1}. The magnitude of the rate constant was shown to be a function of the total irradiation damage experienced by the ice sample. Stabilization of OH radicals at 77° K was studied as a function of total irradiation dosage; saturation is reached at an OH concentration of .8 × 10^{-3}M or 0.003 mole %. The e.p.r. spectrum of a frozen aqueous NO solution was also observed; it consisted of a broad line centred at approximately g = 2.08.

539.19

7797 E.P.R. CHARACTERIZATION OF RADICALS IN IRRADIATED TETRA-n-BUTYL AMMONIUM HALIDES.

E.J.Burrell, Jr.
J. chem. Phys., Vol. 32, No. 3, 955-6 (March, 1960).

The seven line hyperfine patterns observed in $N(C_4H_9)_4I$ and $N(C_4H_9)_4Br$ at 25° C, after irradiation with 2 MeV electrons at −80° C, are attributed to ruptured C—H bonds on the carbon atoms next to the ends of butyl chains. E.F.W.Seymour

539.19

7798 POSSIBLE SYMPTOM OF THE JAHN—TELLER EFFECT IN THE NEGATIVE IONS OF CORONENE AND TRIPHENYLENE.

M G.Townsend and S.I.Weissman.
J. chem. Phys., Vol. 32, No. 1, 309-10 (Jan., 1960).

The electron spin resonance absorption lines of the anions of coronene and triphenylene are broader than those of the anions of most other aromatic hydrocarbons. This broadness is unaffected by changes in concentration, temperature, modulation amplitude, microwave power level or field homogeneity. It is suggested that the broadening may be associated with Jahn—Teller distortions. J.M.Baker

539.19

7799 DYNAMICAL JAHN—TELLER THEOREM.

W.L.Clinton.
J. chem. Phys., Vol. 32, No. 2, 626-7 (Feb., 1960).

A dynamical treatment of the Jahn—Teller effect is outlined. Degenerate electronic states may be interpreted in terms of the infinite number of ways in which the charge distribution can be oriented for a given energy. The moving nuclear framework serves as the perturbation necessary to define the orientation of the charge density. R.C.Seymour

539.19

7800 ISOTOPE EFFECTS IN HIGH RESOLUTION N.M.R. SPECTROSCOPY.

H.S.Gutowsky.
J. chem. Phys., Vol. 31, No. 6, 1683-4 (Dec., 1959).

Several examples are quoted of small shifts of the position of the magnetic resonance of a nucleus in a radical when a deuterium atom replaces a hydrogen atom in the radical. It is suggested that the differences in vibrational amplitude of D and H atoms are the primary cause of such isotopic shifts. A crude, semi-quantitative calculation gives the right order of magnitude for the effect. J.M.Baker

539.19 : 532.7

7801 SOLVENT EFFECTS IN NUCLEAR MAGNETIC RESONANCE SPECTRA.

A.D.Buckingham, T.Schaefer and W.G.Schneider.
J. chem. Phys., Vol. 32, No. 4, 1227-33 (April, 1960).

Contributions to nuclear screening (chemical shifts) arising from molecular interactions with solvent molecules (excluding hydrogen bonding) are discussed in terms of appropriate theoretical models. These include contributions from van der Waals interactions σ_W, from the magnetic anistropy of the solvent molecule σ_a, and from polar effects σ_E. By a suitable choice of solute—solvent systems it has been possible to demonstrate each of these effects experimentally for proton resonances. For CH_4 as a solute, σ_W was in all cases negative, its magnitude varying with the nature of the solvent and amounting to as much as 0.6 ppm for high molecular weight solvents. In agreement with the theoretical models, σ_a found to be positive for disk-shaped solvent molecules and negative for cylindrically symmetrical rod-shaped molecules, its magnitude in extreme cases reaching 0.75 ppm. For CH_3CN as a solute, σ_E was negative and showed the expected dependence on the dielectric constant of the solvent.

539.19

7802 STRONG COUPLING IN NUCLEAR RESONANCE SPECTRA. III. SYSTEMS CONTAINING MANY EQUIVALENT SPINS.

J.S.Waugh and F.W.Dobbs.
J. chem. Phys., Vol. 31, No. 5, 1235-9 (Nov., 1959).

For Pt II, see Abstr. 1507 (1959). The spin-coupling problem is discussed for systems of p + q nuclei falling into two groups A_pB_q where all members of a group are magnetically equivalent. The energies are given explicitly for p = 1, arbitrary q, and formulae are given from which the transition intensities can be computed for this case. The results are applied to the proton resonance spectrum of isobutane (p = 1, q = 9), with the results $\delta_{CH_3} - \delta_{CH} = 0.85$ p.p.m., $A_{CH-CH_3} = 6.8$ c/s.

539.19

7803 N.M.R. CHEMICAL SHIFTS OF ALUMINUM: EXPERIMENTAL DATA AND VARIATIONAL CALCULATION.

D.E.O'Reilly.
J. chem. Phys., Vol. 32, No. 4, 1007-12 (April, 1960).

Chemical shifts of Al^{27} for aluminum alkyl halides, halides, alkyls, alkoxides, AlH_4^-, and $Al(OH)_4^-$ are given. The magnitude of the resonance line width of aluminum compounds as liquids or in solution is indicative of the cubic or noncubic molecular symmetry around the Al^{27} nucleus. The chemical shift of Al^{27} in AlH_4^- is calculated by a variation procedure using both valence bond and molecular orbital type wave-functions. Requirements on variational functions due to time reversal and inversion symmetry are given. Factors determining the shifts of other aluminum compounds are discussed.

539.19

7804 A MOLECULAR ORBITAL ESTIMATE OF INDIRECT PROTON-PROTON SPIN COUPLING IN AMMONIA.

A.Saika.
Physica, Vol. 25, No. 1, 51-2 (Jan., 1959).

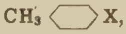
The approximation formulated by McConnell (Abstr. 3069 of 1956), is improved and gives a proton-proton coupling constant in ammonia of 9.5 c/s. This leads to a proton-deuteron coupling constant of 1.5 c/s in NH_2D which should be resolvable in $^{15}NH_2D$ but not in $^{14}NH_2D$. E.J.Burge

539.19

7805 ON THE NATURE OF SOLVENT EFFECTS IN THE PROTON RESONANCE SPECTRA OF UNSATURATED RING COMPOUNDS. I. SUBSTITUTED BENZENES.

T.Schaefer and W.G.Schneider.
J. chem. Phys., Vol. 32, No. 4, 1218-23, (April, 1960).

The relative chemical shift between the resonances of ortho and meta hydrogens in certain para-disubstituted benzenes are markedly dependent on the solvent and concentration. This behaviour, which is observed also in other substituted benzene, is characterized by a pronounced shift of some proton signals to low field in acetone solution and to high field in benzene solution. In compounds of the type



where X is an electron-withdrawing substituent, the resonance signals of protons meta to the X-substituent are displaced selectively in donor solvents. When the CH_3 group is replaced by F, both ortho and meta hydrogens show pronounced shifts. The observations can be interpreted in terms of a specific molecular association involving hydrogen bonding. Although generally these bonds appear relatively weak, for some compounds the hydrogen-bond strength is estimated to be comparable to those formed by chloroform in donor solvents. These effects offer a valuable practical aid in proton resonance measurements since in such compounds, within limits, it is possible to alter the relative chemical shifts by a suitable adjustment of solvent conditions.

539.19

7806 ON THE NATURE OF SOLVENT EFFECTS IN THE PROTON RESONANCE SPECTRA OF UNSATURATED RING COMPOUNDS. II. HETEROCYCLIC COMPOUNDS.

T.Schaefer and W.G.Schneider.

J. chem. Phys., Vol. 32, No. 4, 1224-6 (April, 1960).

In unsaturated heterocyclic compounds, the relative chemical shifts of the protons bonded to the ring are strongly dependent on solvent and concentration. In 6-membered ring compounds, as for example 4-picoline, the β hydrogens show a pronounced shift to low field in acetone solutions and to high field in benzene solutions. This behaviour is similar to the behaviour found for p-substituted toluenes. In the 5-membered heterocyclic compounds, for example pyrrole, the behaviour of α and β hydrogens is reversed, the proton signals of α hydrogens being displaced selectively in acetone and benzene. The results can be interpreted in terms of a preferential bonding of the α protons with the donor solvent molecules.

539.19

7807 PROTON AND B^{11} MAGNETIC RESONANCE OF BORAZOLE. K.Ito, H.Watanabe and M.Kubo.

J. chem. Phys., Vol. 32, No. 3, 947-8 (March, 1960).

The high resolution proton spectrum contains a triplet and a quartet due to protons in $N^{14}H$ and $B^{11}H$ groups respectively. The B^{11} resonance is a doublet with the same splitting as that of the $B^{11}H$ protons. Several weak proton lines are not definitely assigned.

E.F.W.Seymour

539.19

7808 NUCLEAR MAGNETIC RESONANCE SPECTRUM OF THE "DIAMMONIATE OF DIBORANE"

T.P.Onak and I.Shapiro.

J. chem. Phys., Vol. 32, No. 3, 952 (March, 1960).

The high resolution B^{11} spectrum consists of a triplet and a quintet and is consistent with a structure $H_2B(NH_3)_2{}^+.BH_4{}^-$.

E.F.W.Seymour

539.19

7809 SPIN COUPLING BETWEEN PROTONS OF DIFFERENT RINGS IN AROMATIC COMPOUNDS. F.A.L.Anet.

J. chem. Phys., Vol. 32, No. 4, 1274-5 (April, 1960).

A coupling of 0.8 c/s between the 4- and 8-protons was observed in the nuclear magnetic resonance spectra of 5,7-dichloroquinoline and 5,7-dimethylquinoline.

E.F.W.Seymour

539.19

7810 NUCLEAR MAGNETIC RESONANCE IN POLYISOBUTYLENE. J.G.Powles and K.Luszczynski.

Physica, Vol. 25, No. 6, 455-71 (June, 1959).

The proton resonance spin-lattice relaxation time (T_1) and the spin—spin relaxation time (T_2) have been measured for polyisobutylene over the temperature range 20°C to 210°C. There is a minimum in T_1 at 50°C and two values of T_2 above 170°C. The results are interpreted (together with previous results (Abstr. 5293 of 1956), giving second moment values over the temperature range −50°C to +50°C) by correlating them with data on dielectric and mechanical losses and on flow viscosity. It is found that the results can only be consistently interpreted by introducing two main molecular motions differing in frequency by a factor of some 10^3, each involving a distribution of relaxation frequencies. The analysis shows the importance of distributions of relaxation times for nuclear resonance and the uncertainty in the meaning of apparent activation energies deduced from the variation of line width, T_2 or T_1 with temperature. The nuclear resonance measurements reinforce the suggestion from the mechanical, dielectric and viscosity data that one correlation-frequency band is associated with molecular chain motion, probably with a small number of links of the chain as the controlling mechanism. The other slower one is probably associated with the motion of longer sections.

539.19

7811 GROUND STATE ELECTRONIC WAVE FUNCTION OF METHANE. R.K.Nesbet.

J. chem. Phys., Vol. 32, No. 4, 1114-22 (April, 1960).

An approximate electronic wave-function for the ground state of CH_4, in the equilibrium nuclear configuration, is obtained by a variational calculation. Approximate Hartree—Fock molecular orbitals are expanded as linear combinations of a set of basis orbitals of the form $f(x, y, z) \exp(-ar^2)$ centred on carbon and hydrogen. Five independent s orbitals and two p orbitals on carbon are combined with one simple Gaussian orbital on each hydrogen nucleus. The parameters specifying these orbitals were obtained by preliminary variational calculations on the carbon atom. Correlation effects du to all possible Slater determinants constructed from these orbitals are calculated by a perturbation method. Parallel calculations wit the same orbitals were carried out on the ^3P ground state of carbo Calculated ionization potential and dissociation energy are compar with experimental values.

539.1

7812 CALCULATION OF THE DISSOCIATION ENERGY OF NH BY A SEMIEMPIRICAL INTERPOLATIVE METHO

A.L.Companion and F.O.Ellison.

J. chem. Phys., Vol. 32, No. 4, 1132-3 (April, 1960).

Simple valence bond wave-functions (using hybridized orbitals) are constructed for the CH, NH, and OH molecules. The intra-atomic energy is evaluated by Moffitt's atoms-in-molecules metho The interatomic energy is approximated by: (1) replacing heavy-ato 1s electrons by point charges at their nuclei; (2) restricting exchange energy contribution to permutation of bonding electrons; (3) using Mulliken approximation to reduce exchange and hybrid integrals to Coulomb and overlap types; (4) evaluating one-centre integrals by the Pariser approximation and by a new method which utilizes the virial theorem; and (5) expressing two-centre integrals by simplified expressions which give correct semi-empirical value at R = 0 limit and which contain two arbitrary parameters. The latter are adjusted so as to yield correct dissociation energies of CH and OH. The dissociation energy of NH is then found to be 3.61 eV, which lies within the uncertainty of the best experimental result 3.6 ± 0.5 eV. Calculated degrees of hybridization agree wel with previous estimates.

539.

7813 MICROWAVE SPECTRUM AND MOLECULAR STRUCTURE OF MONOCHLOROACETONITRILE.

J.D.Graybeal.

J. chem. Phys., Vol. 32, No. 4, 1258-60 (April, 1960).

The microwave spectrum was measured and analyzed. By assuming certain molecular parameters the structure of the plana framework was determined from the moments of inertia of two isotopic species. The C—Cl and C—C bond lengths were found to b 1.767 A and 1.472 A, respectively. The CCCl angle was found to be 111°24'. The H...H distance was found to be 1.728 A. The chlorine nuclear quadrupole coupling constant along the C—Cl bond axis was calculated to be −76.36 Mc/s. The direction of the dipole moment was estimated to be between the C—Cl and C—CN bond directions, 28° from the latter. The observed C—Cl distance, in addition to the observed nuclear quadrupole coupling constants in the solid an gaseous molecules, are indications that there is very little double bond character in the C—Cl bond. The ionic character of the C—C bond was estimated to be 18%.

539.1

7814 DECAY RATES OF BOUND NEGATIVE MUONS. D.D.Yovanovitch.

Phys. Rev., Vol. 117, No. 6, 1580-9 (March 15, 1960).

The decay rate of negative muons bound to nuclei of atomic number Z, $\Lambda_d(Z)$, was investigated experimentally by two independent methods: (a) the "sandwich" method, and (b) the "calibrated efficiency" method. Both methods are based on the fact that the negatron yield per muon, $y^-(Z)$, is proportional to $\Lambda_d(Z)/\Lambda_t(Z)$, where $\Lambda_t(Z)$ is the total disappearance rate of negative muons for element Z, and are designed to avoid absolute measurements of $y^-(Z)$. In method (a), μ^- are stopped in a multilayer "sandwich" target made by alternately stacking sheets of two elements Z, Z', and the resultant e^- time distribution is decomposed into componen due to Z and Z'. The ratio of muon stops in Z and Z' is establishe empirically; knowing $\Lambda_d(Z')$, $\Lambda_d(Z)$ can be computed. This metho was applied to Al, Fe, Zn, Cd, Mo, W, and Pb. In method (b), μ^- and μ^+ of identical range distributions are stopped in a given target, and the e^+ yield, y^+, is used as a calibration of the e^- counting efficiency. This method was applied to C, Ca, Ti, V, Mn, Fe, Co, Ni, Zn, I, and Pb. The sources of error of either method are discussed in detail. The results indicate: (1) In the range $20 < Z < 30$, $\Lambda_d(Z) > \Lambda_d(0)$, i.e., the bound decay rate exceeds the vacuum (i.e., μ^+) decay rate; $\Lambda_d(Z)$ presents a sharp peak near Z = 26. (2) For $Z > 30$, one finds $\Lambda_d(Z) < \Lambda_d(0)$, i.e., the decay is inhibited by binding. The effect is very marked for the heaviest elements, e.g., $\Lambda_d(82)/\Lambda_d(0) = 0.34 \pm 0.04$. These results are compared with the predictions of simplified theoretical models.

The peak near Z = 26 is tentatively attributed to the Coulomb enhancement of the outgoing electron wave-function at the point of decay.

539.19

7815 THE CALCULATION OF SOME PROPERTIES OF HYDROGEN GAS AT LOW TEMPERATURES.

P.D.Niblett and K.Takayanagi.

Proc. Roy. Soc. A, Vol. 1261, 222-47 (March, 10, 1959).

Some further study of molecular collisions using a non-spherical intermolecular potential in hydrogen gas at low temperatures is presented. Pairs of coupled equations for radial wave functions for the para—ortho collision problem are solved numerically using an electronic computer. The para—para collisions are also studied. The results make it likely that the difference between the viscosity cross-sections for para—para and para—ortho collisions can be explained mainly by the non-spherical nature of the potential, together with the effect of the statistics applicable in the various cases. The second virial coefficient is also calculated.

539.19

7816 COMPLETE CLASSICAL THEORY OF VIBRATIONAL ENERGY EXCHANGE.

D. Rapp.

J. chem. Phys., Vol. 32, No. 3, 735-7 (March, 1960).

By using purely classical mechanics, the amount of energy ΔE_{vib} transferred to a harmonic oscillator molecule in a head-on molecular collision of velocity v_0 is calculated. In the classical limit for small transition probabilities, the quantum-mechanical probability per collision of going from the ground state to the first excited state is given by $P_{0\to 1} = (\Delta E_{vib}/h\omega)$, where ω is the frequency of the oscillator, and ΔE_{vib} is the energy classically transferred to the oscillator in one collision. This transition probability is integrated over a normalized distribution of collision velocities to give an average probability for all collisions $(P_{1\to 0})$. Finally, $(P_{1\to 0})$ is calculated from the law of microscopic reversibility. The result turns out to be the same as that obtained by Herzfeld, who used a quantum-mechanical perturbation treatment and went to the classical limit by assuming that the de Broglie wavelength of the molecule colliding with the oscillator is small compared to the range of the intermolecular forces.

539.19

7817 EFFICIENCIES OF ADDITIVES IN THE TRANSFER OF VIBRATIONAL ENERGY IN ETHYLENE AND NITROUS OXIDE.

J.W.Arnold, J.C.McCoubrey and A.R.Ubbelohde.

Proc. Roy. Soc. A, Vol. 248, 445-59 (Dec. 9, 1958).

Using ethylene or nitrous oxide as test molecules which contain different atoms and exhibit different internal modes of motion, measurements of the dispersion of ultrasonic velocities have been used to obtain information about vibrational energy transfer in the pure gases, and with a number of polyatomic molecules as additives. Much more efficient transfer is found with many of these additives than in self collisions. Even molecules such as benzene which are relatively inefficient in self collisions are good energy transfer catalysts in hetero-collisions. Mechanisms of energy transfer additional to the "high velocity impacts" of Landau and Teller are discussed. In hetero-collisions with polyatomic molecules, vibration-vibration transfers offer one possibility. Wrestling collisions or profound perturbations of the energy levels of the vibrators by dipole fields also appear to be important.

539.19

7818 ON THE ADDITIVITY OF LONDON—VAN DER WAALS FORCES. AN EXTENSION OF LONDON'S OSCILLATOR MODEL.

M.J.Sparnaay.

Physica, Vol. 25, No. 3, 217-30 (March, 1959).

Calculations are given concerning the additivity of London—Van der Waals forces between two groups of atoms, the atoms being represented as isotropic harmonic oscillators. The results indicate that deviations of 10-30% from additivity can be obtained if only dipole—dipole interaction between oscillator of one group is assumed. The effect can be expected to be relatively large if the symmetry of the arrangements of the oscillators in the group is low and it is dependent upon the relative spatial position of the groups.

539.19

7819 VAN DER WAALS FORCES AND FLUCTUATION PHENOMENA.

M.J.Sparnaay.

Physica, Vol. 25, No. 6, 444-54 (June, 1959).

An expression is given for the attraction between two electrically neutral systems each consisting of electric point charges which move at random inside spherical volumes. The calculation is based on the use of mean square values of density fluctuations in each system. The result and the method used are compared with Keesom's expression for the interaction between two dipoles and with the expression which is obtained for the interaction of two classical harmonic oscillators a large distance apart.

539.19

7820 ANALYSIS OF THE SOLUBILITY BEHAVIOUR OF IRRADIATED POLYETHYLENE AND OTHER POLYMERS.

A.Charlesby.

Proc. Roy. Soc. A. Vol. 249, 367-86 (Jan. 13, 1959).

The equation for the sol fraction (s) of a cross-linked polymer network becomes readily tractable when applied to special cases of the generalized distribution function $n(u) = C(u/u_1)^{\lambda-1} \exp(-\lambda u/u_1)$. For values of $\lambda = \infty$, 1 and 0 respectively, this function yields the uniform distribution, the exponential distribution and a hypothetical pseudo-random distribution. Assuming that cross-linking and fracture occur at random and in proportion to the radiation dose, simple expressions are derived relating sol fraction to radiation dose (r) for each of the three distributions. The most useful of these is the relation involving the fracture density per unit dose (p_0) and the density of cross-linked units per unit dose (q_0). $s + \sqrt{s} = p_0/q_0 + 1/q_0 u_1 r$. This holds strictly for exponential distributions, whether or not main-chain fracture occurs simultaneously with cross-linking, and also holds at high doses for the other distributions considered, providing that cross-linking is accompanied by fracture. This treatment is applied to experimental results on low-density and high-density polyethylenes, polyvinyl acetates, polyvinyl chloride, polypropylene and polyalkyl acrylates. The relevant radiation parameters $p_0 q_0$ and the corresponding G values are deduced. It is found, in the case of polythylene, that q_0 is, within experimental error, independent of the molecular weight, degree of branching or crystallinity, but is affected by the presence of air. Similar values of q_0 are also observed for polyvinyl acetate and polyvinyl chloride.

539.19

7821 DETERMINATION OF EFFECTIVE DIPOLE MOMENTS OF POLYMERS OF HOMOLOGOUS METHACRYLIC ESTERS IN SOLUTION AND IN THE HIGHLY ELASTIC STATE.

G.P.Mikhailov and L.L.Burshtein.

Zh. tekh. Fiz., Vol. 29, No. 2, 192-7 (Feb., 1959). In Russian.
English translation in: Soviet Physics—Technical Physics (New York), Vol. 4, No. 2, 165-70 (Feb., 1959).

Describes the results of an investigation of molecular interaction by means of the method of effective dipole moments. Apart from the properties of the isolated macromolecule, the effective dipole moments were studied of polymers of this series in the highly elastic state, in which the interaction between polar groups of different macromolecules cannot be excluded. The results point to the existence of an interaction between polar groups of the same polymer chain. Moreover, an increase in the number of nonpolar CH_2 groups in the side chain does not substantially affect molecular interaction in the macromolecule. The results indicate the absence of an interaction between polar groups of different macromolecules, which may point to the determining influence of the internal molecular interaction in a macromolecule on the highly elastic properties of a polymer.

539.19 : 539.14

INTERACTIONS OF NUCLEAR SPIN WITH ELECTRONS IN NEIGHBORING MOLECULES. See Abstr. 7455

539.19

7822 COMPARISON OF THE MOLECULAR WEIGHTS OF DEOXYRIBONUCLEIC ACIDS AS DETERMINED FROM LIGHT SCATTERING AND FROM SEDIMENTATION AND VISCOSITY.

J.A.V.Butler, D.J.R.Laurence, A.B.Robins and K.V.Shooter.

Proc. Roy. Soc. A, Vol. 250, 1-21 (Feb. 24, 1959).

Measurements have been made of (1) light scattering, (2) sedimentation characteristics, and (3) viscosities of identical, well-clarified solutions of a considerable number of preparations of DNA from various sources and under conditions which permit extrapolation of the relevant molecular quantities to zero concentration. In order to increase the range of sizes examined, similar observations have been made with specimens which had been irradiated with 15 MeV electrons or X-rays. It is found that, to a rough approximation, the relation $S_0 \alpha [\eta]^{1/3}$ holds for all samples (except those which were heated). There does not appear to be any correlation between M_L, the molecular weight determined by light scattering and either $[\eta]$ or S_0. Values of $M_{\eta,s}$ from viscosity and sedimentation data have been calculated using the equation of Mandelkern, Flory, Krigbaum and Scheraga (1952) and it was found that with the unirradiated samples these values did not agree with M_L, although reasonable agreement was obtained with the irradiated samples. The validity of the calculation of $M_{\eta,s}$ is discussed. Analysis of the angular variation of the light scattering shows no significant change in the flexibility of the coils upon irradiation, in contrast with the effect of heating where a large change of flexibility occurs. This is in agreement with the hydrodynamic relations given above. Consequently, the differences between irradiated and unirradiated DNA cannot be ascribed to changes of flexibility and the need to use a different model on that account. Since S_0 and $[\eta]$ are both decreased by small doses of radiation, it is difficult to avoid the conclusion that real changes of molecular weight occur, which have not been discovered by the light-scattering method as employed here. It is shown that both for rods and coils there is an upper limit, at finite angles, to the light scattered by a given concentration of polymer, as the size is increased. For a molecule intermediate between a rod and a coil, the limiting curve may appear to have a finite intercept owing to a concealed high curvature at very small angles of scattering. This may set an upper limit to the observed molecular weight for a given degree of flexibility. If the main effect of irradiation is a decrease of molecular weight without marked changes of flexibility, it is difficult to avoid the conclusion either that single chain breaks do not influence the flexibility of the particle or that a high proportion of double breaks occurs.

539.19

7823 THE SIZE AND SHAPE OF LARGE MOLECULES IN SOLUTION. J.H.S.Green.
Sci. Progr., Vol. 47, 661-83 (Oct., 1959).

An attempt is made to explain the concepts of size and shape of linear flexible macromolecules in solution. Experimental methods of obtaining relevant data by the measurements of viscosity, light scattering, sedimentation and diffusion are described and some of the hydrodynamic theories are discussed. Experimental evidence relating to the chain dimensions and the theories presented are discussed in the light of results for some typical polymers.

R.A.Ballinger

539.19 : 531.75

7824 TORSION BALANCE MEASUREMENTS WITH MOLECULAR BEAMS. D.W.Bassett and A.J.B.Robertson.
Brit. J. appl. Phys., Vol. 10, No. 12, 534-8 (Dec., 1959).

A torsion balance is described for measuring the momentum carried by the molecules in a molecular beam with an intensity of about 10^{12} mol./s or more. The beam struck a vane suspended on a platinum fibre 3 μ in diameter. The balance could be used at elevated temperatures. At room temperature, measurements of the balance deflection were made to 1 part in 500, under favourable conditions. An investigation was made of the intensity of a molecular beam of carbon dioxide formed by a fairly simple molecular-beam generator, which is described. Deviations of gas flow from molecular flow and attenuation of the beam by scattering were important factors.

539.19 : 621.37

7825 MOLECULAR BEAM FORMATION BY LONG PARALLEL TUBES. J.A.Giordmaine and T.C.Wang.
J. appl. Phys., Vol. 31, No. 3, 463-71 (March, 1960).

The characteristics of molecular beams formed by sources consisting of long tube arrays are measured for several sources. The peak beam intensity and the beam width are calculated when collisions in the source are taken into account under the assumpti that a limited region of Knudsen type flow occurs near the low pre sure end of the source. The peak beam intensity and the beam wi are calculated to vary as the square root of the total flow rate for source pressures giving useful directivity, in good agreement wit the observations. Considerations in the design of sources are discussed.

539.19 : 538.56 : 621.375.

7826 FOCUSING MOLECULAR BEAMS OF NH_3. J.C.Helmer, F.B.Jacobus and P.A.Sturrock.
J. appl. Phys., Vol. 31, No. 3, 458-63 (March, 1960).

The problem of forming molecular beams for use in ammonia masers is examined. It is shown theoretically and experimentally that through the use of a new type of parabolic focuser with a "poi source" effuser, the molecular flow may either be reduced by a factor of 8, for the same power output, or the power output may be increased by a factor of 2 for the same molecular flow. A theory beam formation in a multitube effuser is described. This shows th the most intense molecular beam is formed by an effuser of small over all diameter. Design considerations are discussed for parabolic, upper-state focusers, and for coaxial, lower-state focusers. The operation of a system is described, using a lower-state focuser an an ionization detector, in which lower-state molecules produced by maser oscillation may be detected.

539.

7827 MOLECULAR TRAJECTORIES IN ELECTRIC FIELDS AND STATE SELECTION IN A BEAM OF SODIUM CHLORIDE. M.Peter, H.G.R.Venkates and M.W.P.Strandberg.
J. appl. Phys., Vol. 31, No. 4, 693-6 (April, 1960).

A molecular beam of sodium chloride can be partially sorted with respect to the rotational levels of the molecule when it is passed through an inhomogeneous electric field. The possibility of state selection of the beam in one of the lower rotational states of the molecule ($J = 2$, $|M| = 0, 1, 2$) has been investigated by studyin the molecular trajectories for the rotational states $J = 1$; $|M| = 1,$ and $J = 2$; $|M|$ 2, 1, 0. A typical calculation for a state selector is given.

539.19 : 539.

7828 μ^--MESIC MOLECULAR PROCESSES IN HYDROGEN. V.B.Belyaev, S.S.Gershtein, B.N.Zakhar'ev and S.P.Lomnev.
Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1652-62 (Dec., 1959). In Russian.

A number of mesic atomic and mesic molecular processes in medium of hydrogen isotopes (formation of mesic molecules, $H_\mu^{(1)} + H^{(2)} \rightarrow (H^{(1)}H^{(2)})_\mu$, elastic collisions and charge exchange of mesic atoms $H_\mu^{(1)} + H^{(2)} \rightarrow H_\mu^{(1)} + H^{(2)}$, $H_\mu^{(1)} + H^{(2)} \rightarrow H^{(1)} + H_\mu^{(2)}$) ar considered. The levels of the mesic molecules are determined. The computations were performed on the BESM electronic comput with corrections (of the order of m_μ/M) for the motion of the nucl

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539.2 : 532.7

7829 MAXWELL–AMPERE CONFERENCE - LONDON, 1959.
Arch. Sci. (Geneva), Vol. 12, Special No., 251 pp. (1959).

For abstracts of all papers not published elsewhere, see Abstr. 180, 12201, 12203-5, 12210, 12213, 12215-18, 12467, 12479-80, 487-8, 12493-8, 12503, 13226, 13244, 13467, 13475, 13478, 13485 959); 91, 505, 667,681 (1960).

539.2

7830 THE STATISTICAL MODEL OF METALLIC TUNGSTEN.
L.Szász.
cta phys. Hungar., Vol. 7, No. 2, 225-49 (1957). In German.

The aim of the present work is to determine certain electron tructure- and cohesion-dependent constants of tungsten on the basis of e statistical model for a metal. This model, developed by Gombás, ssumes that the conduction electrons are subject to a modified ttice potential; this potential includes a term which reflects the teraction energy between the conduction electrons. It is assumed hat the number of valence electrons per tungsten atom is six. The tatistical model is used to determine the lower edge of the s and d ands. The former is calculated to lie about 5.5 eV below the latter. he wave-functions of the conduction electrons are assumed to be of he plane wave type and their distribution function is approximated o the parabolic form of the free-electron functions even in the nergy range which corresponds to the Brillouin zone boundaries. With these assumptions the lattice energy, the lattice parameter, he compressibility and the specific heat of the conduction electrons f tungsten is calculated. Good agreement with the empirical values s found. R.Parker

539.2

7831 THE PROPERTIES OF CRYSTALS WITH HYPOTHETICAL CLOSE-PACKED STRUCTURES. A.V.Stepanov.
Fiz. tverdogo Tela, Vol. 1, No. 4, 671-3 (April, 1959).

Lattice energy, compressibility, melting point, boiling point, critical point, density, characteristic (Debye) temperature, theoretical strength, are calculated for hypothetical structures with face-centred atomic packing (12 coordination) as if they were made up of atoms joined as in the following bonds or compounds:- C—C (aliphatic), N_2, H_2, O_2, As_2, P_2, Sb_2, Bi_2, S_2, Se_2, Te_2, I_2, CH_4, Cl_2, HgI_2, C_6H_6. For example, hydrogen would have : atomic radius, 0.74 A; lattice energy, 869 kcal/mol; compressibility, 9.2×10^5 kg/mm^2, m.p. 7 000°K; b.p. 37 000°K; critical point, 67 000°K; density, 5.7 gm/cm^3; characteristic temperature, 13 000°K; theoretical strength, 0.92×10^5 kg/mm^2. A.L.Mackay

539.2

7832 DIRECT CATION—CATION INTERACTIONS IN SEVERAL OXIDES. J.B.Goodenough.
Phys. Rev., Vol. 117, No. 6, 1442-51 (March 15, 1960).

It is pointed out that interactions between octahedral-site cations are cation—anion—cation interactions if the cation-occupied octahedra share a common corner, but may be primarily cation—cation (no anion intermediary) if the cation-occupied octahedra share either a common edge or a common face. It is further pointed out that cation- -cation interactions may be naturally classified as "strong" or "weak" since there is a critical cation separation below which the interacting electrons are best described by a collective-electron model, above which by a Heitler—London model. The characteristics of the different interactions under varying conditions are summarized. In the case of strong cation- -cation interactions, covalent-type bonds may be formed at low temperatures. The resulting phase transitions are marked by the following features: (1) the transitions may be noncooperative (isolated cation—cation pairing introducing no symmetry change to the structure) and extend over a considerable temperature interval ($\Delta T \sim 100°$C), or cooperative, occurring at a definite temperature and exhibiting thermal hysteresis. (2) Bonded cations are displaced from the centre of symmetry of their anion interstice (in contrast to Jahn—Teller or spin—orbit distortions). (3) Bonding electrons are spin-paired so that they make no contribution to the atomic moment unless localized, unpaired d electrons are simultaneously present to weaken the covalent-type bond via intra-atomic exchange. (4) Bonding electrons cannot contribute to metallic-type conductivity so that if the bond-forming phase ties up all of the outer d electrons in covalent-type bonds, the transition is semiconducting $\rightleftharpoons$ metallic. The physical properties of several compounds that illustrate the importance of the cation- -cation interactions are discussed.

539.2

7833 BONDING IN CADMIUM TELLURIDE.
C.H.L.Goodman.
Proc. Phys. Soc., Vol. 74, 489-90 (Oct., 1959).

It is suggested that the bonding in cadmium telluride is "neutral" rather than co-valent (see Abstr. 6228 of 1959) and that refractive indices measured at longer wavelengths than 1.1μ would help to estimate the effective ionic charge. G.F.J.Garlick

539.2

7834 THE EXTENT OF IONIC BINDING IN CADMIUM TELLURIDE. T.S.Moss.
Proc. Phys. Soc., Vol. 74, Pt 4, 490-1 (Oct., 1959).

See preceding abstract (also Abstr. 6228 of 1959). By combining the data from various sources an estimate of effective charges on the ions in cadmium telluride can be made. Values of $e^* \sim 0.62$-$0.95e$ are obtained and a large degree of ionicity is indicated. G.F.J.Garlick

539.2

7835 BULK DENSITIES OF SEPARATED COPPER ISOTOPES.
D.D.Snyder.
J. appl. Phys., Vol. 31, No. 2, 440-1 (Feb., 1960).

Measurement of the bulk densities of separated Cu isotopes is hampered by the fact that the drawing of Cu into a fine wire may give rise to trapped gases. When this difficulty is overcome the bulk density measurements give densities that are slightly smaller than the densities calculated from crystallographic data. J.Thewlis

539.2

7836 EXTENSION OF THE MADELUNG METHOD FOR THE EVALUATION OF LATTICE SUMS.
F.G.Fumi and M.P.Tosi.
Phys. Rev., Vol. 117, No. 6, 1466-8 (March 15, 1960).

The Madelung formulas for the electrostatic potential of a linear or planar Bravais lattice of ions, neutralized by a uniform distribution of charge, are extended to the lattice sums over a linear or planar Bravais lattice involving two-body interactions of the type R^{-n} (R, interatomic distance; $n > 0$), evaluated at points outside the lattice. The application of these generalized Madelung formulas in the evaluation of the specific face energy for neutral planes of an ionic solid of composition MX is briefly discussed.

539.2

7837 THE ELECTROSTATIC POTENTIAL IN MULTIPOLE LATTICES. F.W.de Wette and B.R.A.Nijboer.
Physica, Vol. 24, No. 12, 1105-18 (Dec., 1958).

General expressions for the electrostatic potential in perfect multipole lattices are given as expansions in terms of spherical harmonics. The coefficients occurring in these expansions contain lattice sums of a general type, which have been treated previously. Such expressions are derived for a point charge lattice, a multipole lattice, and finally for a lattice built up from a number of different arbitrary charge distributions.

539.2

7838 SURFACE MIGRATION OF NITROGEN ON TUNGSTEN.
G.Ehrlich and F.G.Hudda.
J. chem. Phys., Vol. 32, No. 3, 942-3 (March, 1960).

Briefly reports the direct observation of the migration of nitrogen over a single crystal of tungsten. Using a simple field emission ion microscope with walls cooled by liquid hydrogen it was possible to deposit nitrogen on the tungsten tip and study its migration as the tip temperature was varied. Four distinct regimes of binding have been observed. A.E.I. Research Laboratory

539.2

7839 DETERMINATION OF THE SURFACE TENSION AND SURFACE MIGRATION CONSTANTS FOR TUNGSTEN.
J.P.Barbour, F.M.Charbonnier, W.W.Dolan, W.P.Dyke, E.E.Martin and J.K.Trolan.
Phys. Rev., Vol. 117, No. 6, 1452-9 (March 15, 1960).

A determination of the surface tension and surface migration constants of metals in the solid phase, based on the use of pulsed field emission microscopy, is discussed. The experimental technique is described. An application to field emission cathodes of Herring's theory of transport phenomena in solids is given, which yields the necessary relations required for the determination of the basic physical constants from the experimental data. Results are presented and discussed for the case of tungsten. The method is applicable to a number of other metals.

Lattice Dynamics

539.2 : 532.7 : 539.12

7840 SOLID AND LIQUID STATE RESEARCH WITH COLD NEUTRONS. P.A. Egelstaff.

Brit. J. appl. Phys., Vol. 10, No. 1, 1-9 (Jan., 1959).

The theoretical background is covered in a general way only, but the properties of the energy transfer processes and the information they yield concerning the thermal behaviour of matter are emphasized. Experimental work is discussed historically where appropriate and numerous recent experiments are mentioned (without considering any one in detail) to illustrate the many branches of these fields into which cold neutron research is moving. With the current improvements in experimental neutron fluxes and techniques, cold neutron methods will be used extensively during the next decade for solid and liquid state research.

539.2

7841 ON THE LATTICE ENERGY OF ALKALI HALIDES. V.Hovi and K.Mansikka.

Ann. Univ. Turku, A1, No. 40, 8 pp. (1960).

Lattice energies have been calculated for all alkali halides at 298° K, from the most recent experimental data, by means of the Born—Haber cycle. The results are in good agreement with the theoretical data given by Verwey and de Boer (1936) and by Huggins (1937). In the cases of NaCl and KCl, they also agree well with Löwdin's (1950) theoretical data. The present results are, within experimental error, the same as those determined by Morris (1956) for 0° K. Thus the experimental lattice energies at 298° K and 0° K differ so little from each other that, after taking into account the errors in some of the quantities used in the Born—Haber cycle, it is hardly necessary to correct the room temperature values of the lattice energies by means of vibrational and zero point energies for verification of the theoretical results. Some interesting regularities between the lattice energies of the alkali halides have been found.

539.2

7842 STUDY OF LATTICE BY RESONANCE ABSORPTION OF NUCLEAR GAMMA RAYS. W.M.Visscher.

Ann. Phys. (New York), Vol. 9, No. 2, 194-210 (Feb., 1960).

It has recently been demonstrated by Mössbauer that in a large proportion of emissions or absorptions of gamma rays by nuclei bound in crystals at low temperature the recoil energy is taken up by the crystal as a whole (no phonons are emitted). This makes it possible to observe resonance absorption of nuclear gamma-rays without high-speed rotors or elevated temperatures, as had been done in the past. In the present paper it is shown that an extension of Mössbauer's technique can be utilized to directly observe the frequency distribution of lattice vibrations in the crystal. Specifically, if the emitter and absorber have the same favourable crystal structure, then the self-absorption cross-section observed in a rotor experiment at low temperature will be proportional to N(S)/S, where N(S)dS is the number of phonon states in an energy interval dS, and S is the Doppler shift in the gamma-ray energy induced by the rotor motion. Criteria are given for determining favourable cases.

539.2 : 539.14

EFFECT OF ABSORPTION OR EMISSION OF γ-RAYS BY BOUND NUCLEI ON A CRYSTAL LATTICE. See Abstr. 7461

539.2

7843 LOW-FREQUENCY VIBRATIONS OF THE CRYSTAL LATTICE OF ICE. A.Kahane.

C.R. Acad. Sci. (Paris), Vol. 250, No. 3, 500-2 (Jan. 18, 1960).
In French.

A single crystal of ice shows a polarized Raman line at 226 cm^{-1} from which is deduced a force constant of 2×10^4 dynes/cm for the bond O—H → O, comparable with the value for this bond in KH_2PO_4. G.F Lothian

539.2

7844 THE FREQUENCY SPECTRUM OF A CHAIN OF ATOMS, TAKING ACCOUNT OF INTERACTIONS OF ANY DESIRED ORDER. A.N.Men'.

Fiz. Metallov i Metallovedenie, Vol. 7, No. 3, 450-3 (1959).
In Russian.

Elastic interactions between atoms other than nearest neighbo are taken into account and the frequency spectrum of a one-dimensional crystal is calculated. Special cases are discussed where th number of atoms in the chain is odd, even or prime. The results agree with those obtained by Peierls [Quantum Theory of Solids. London: Oxford University Press (1956), Chapter 5]. A.F.Brow

539

7845 VIBRATIONAL SPECTRA OF DIATOMIC CHAINS. P.Dean.

Proc. Roy. Soc. A, Vol. 254, 507-21 (March 8, 1960).

For previous work, see Abstr. 7493 (1959). Quantitatively ac rate results for the vibrational spectra of disordered diatomic chains have been computed for four systems over a complete rang of lattice order. The spectra obtained are far more complex than hitherto been suspected, a most detailed array of peaks and valley becoming apparent for the completely disordered chain at a mass ratio of about 2. The theory of defect modes in nearly ordered lattices shows the association of a number of the peaks with particular kinds of localized chain structure and points the way to possible developments for three-dimensional systems.

539

7846 ON THE DISPERSION OF PHONONS IN METALS. G.K.Horton,

Proc. Roy. Soc. A, Vol. 252, 551-60 (Oct. 27, 1959).

The measured dispersion law for copper and aluminium is use to find the corresponding heat capacity at constant volume without recourse to a force-constant model for interpolation purposes. Th discussion is confined to the harmonic approximation. Thermal expansion of the lattice is allowed for by the usual thermodynamic relations which are presented in a particularly convenient form. The use of perturbation theory is examined in some detail. It is found that while it may be made plausible from certain experiment results on slow neutron scattering, a theoretical justification is absent. Next it is shown how both systematic and random errors i the measured dispersion law would affect the specific heat. It is found that the dispersion data available at present are not nearly accurate enough to distinguish the specific heat calculated from th from the directly measured values. The agreement is substantiall better for copper than for aluminium. Finally, the three-constant, first- and second-neighbour, central-force theory is briefly discus It is shown that a correct use of the equilibrium conditions, which involves one more parameter than the conventional treatment, doe not change Θ_0, Θ_∞ and the dispersion law in the (111) direction fro the conventional values. A plausible choice of the extra force cons from the other two sets of dispersion relations destroys the exact agreement between the conventional central-force theory and the calorimetric data for copper.

539

7847 LATTICE VIBRATIONS AND SPECIFIC HEAT OF ZI BLENDE. A.K.Rajagopal and R.Srinivisan.

Z. Phys., Vol. 158, No. 4, 471-82 (1960).

The dispersion relations, frequency distribution function and specific heat of zinc blende are calculated using Houston's metho on: (1) a short-range force (S.R.) model of the type employed in diamond by Smith (Abstr. 4023 of 1948); (2) a long-range model assuming an effective charge Ze on the ions. Since the elastic constant data from various sources on ZnS are not in agreement, following values are used: $C_{11} = 10.78$; $C_{12} = 6.87$ and $C_{44} = 3.87$ in 10^{11} dynes/cm^2. Compared with the results on the S.R. model, th Coulomb force causes: (1) a splitting of the optical branches at (000) and a larger dispersion of these branches; (2) a rise in the acoustic branch along [110]; (3) a bridging of the gap of forbidden frequencies in the S.R. model; (4) a reduction of the moments of the frequency distribution function; (5) a flattening of the $\Theta - T$ curve. By plotting (Θ/Θ_0) against T_1, the experimental data of Martin (Abstr. 7923 of 1955) and Clusius and Harteck (Abstr. 2758 of 1928) are found to be in perfect coincidence with the curve for t short range model. The values of the elastic constants deduced from the ratio Θ_0 (Theor)/Θ_0 (Expt) agree with those of Prince and Wooster (1951). This is surprising, as evidence indicates that th bond in zinc blende is partly covalent and partly ionic. It is concluded that the effective charge in ZnS is a function of the wave vector κ.

539.2

7848 SPECIFIC HEAT OF CHROMIUM–IRON ALLOYS AT ROOM TEMPERATURE. K.Schröder.

Phys. Rev., Vol. 117, No. 6, 1500-1 (March 15, 1960).

The specific heat of b.c.c. iron–chromium solid solution alloys was measured at room temperature and then calculated under simplified assumptions from lattice, magnetic, and electronic terms. The magnetic atomic heat was evaluated using the simple Weiss theory. The electronic term was assumed to be equal to γT, where the value of γ used was that obtained earlier from low-temperature specific heat measurements. The lattice term was taken to be the same for all alloys. Reasonable quantitative agreement between the calculated and the measured values was achieved.

539.2

7849 ON THE HEAT CAPACITY OF CRYSTALLINE MAGNESIUM OXIDE.

T.H.K.Barron, W.T.Berg and J.A.Morrison.

Proc. Roy. Soc. A, Vol. 250, 70-83 (Feb. 24, 1959).

The heat capacity of single crystals of magnesium oxide has been measured in the temperature range 3 to 270°K with estimated accuracies of ± 0.5% for $10 < T < 20°K$ and ± 0.2% for $T > 20°K$. Reliable results were not obtained below 10°K because of desorption of helium exchange gas in the calorimeter vessel. With the assumption that the effect of anharmonicity of the lattice vibrations may be neglected for $T < \frac{1}{3}\,\Theta_D$, the experimental results have been analysed to obtain a number of properties of an effective harmonic frequency spectrum of magnesium oxide. In particular, several negative moments, three even positive moments, and the coefficients of the first three terms in the low-frequency expansion have been calculated. From the low-frequency expansion the apparent Debye characteristic temperature at 0°K (Θ_0) is calculated to be 946 ± 4°K, in good agreement with the measured elastic constants (Θ (elastic) = 949°K). The zero-point energy is found to be 3455 ± 25 cal mole^{-1} deg^{-1}; it is pointed out that zero-point energy will cause some anharmonic effects even at the lowest temperatures. A comparison with the heat capacities and elastic constants of the alkali halides suggests that the interatomic forces in magnesium oxide may be rather similar to those in lithium fluoride. The difference between the present heat capacity results and earlier results of Giauque and Archibald (1937) for small particles of magnesium oxide is much larger than that predicted by theoretical estimates of the effect of particle size on the heat capacity of solids. A simple theoretical approximation is derived for the change of Θ_∞ with particle size; there again the experimental change is found to be much larger.

539.2

7850 ON THE EVALUATION OF EQUIVALENT DEBYE TEMPERATURES AND RELATED PROBLEMS.

G.K.Horton and H.Schiff.

Proc. Roy. Soc. A, Vol. 1261, 248-65 (March 10, 1959).

The heat capacity, at constant (0°K) volume, of face-centred cubic crystals is evaluated by a modified Houston (1948) approximation. The procedure is applied, by way of illustration, to five representative face-centred cubic metals, Al, Ag, Au, Cu and Pb. The nearest-neighbour non-central force theory of Begbie and Born (1947) is used, together with the nearest- and next-nearest-neighbour central force theory previously used by Leighton (1948). At each temperature the force constants used are derived from the elastic constants, measured experimentally at that temperature, by the method of long waves. To this extent, at least, anharmonic effects are taken into account. It is found, as was to be expected, that neither theory can quantitatively account for the measured specific heats of the metals studied. The method may be used in the discussion of related problems such as the thermal expansion of crystals and the thermal conductivity of insulators.

539.2

7851 THE SPECIFIC HEAT OF SODIUM FROM 20 TO 300°K: THE MARTENSITIC TRANSFORMATION. D.L.Martin.

Proc. Roy. Soc. A, Vol. 254, 433-43 (March 8, 1960).

Measurements on a cast sample and an extruded sample are reported. There is no significant difference in behaviour. No anomaly of the type reported by Dauphinee et al. (Abstr. 3395 of 1954) was found. A thermal study of the martensitic transformation showed a large specific-heat anomaly in the reversion region and a specific-heat dependent on thermal history in the two-phase region. The heat of transformation from hexagonal close-packed to body-centred cubic sodium is deduced to be about 10 cal/g atom and the Debye temperatures of the two phases at 20°K to be 160 and 153°K respectively. The entropy at 298.15°K is 12.24 ± 0.12 cam/°K atom.

539.2

7852 THE SPECIFIC HEAT OF LITHIUM FROM 20 TO 300°K: THE MARTENSITIC TRANSFORMATION. D.L.Martin.

Proc. Roy. Soc. A, Vol. 254, 444-54 (March 8, 1960).

Measurements on lithium of atomic weight 6.945 are reported. A thermal study of the martensitic transformation showed a large specific-heat anomaly in the reversion region and a specific heat dependent upon thermal history in the two-phase region. The high-temperature end of the reversion anomaly shows time effects which suggest that the process here is controlled by a spectrum of activation energies of the same order of magnitude as that for self-diffusion. With some assumptions the heat of transformation from hexagonal close-packed to body-centered cubic lithium is deduced to be about 14 cal/g atom and the Debye temperatures of the two phases at 60°K are 390 and 371°K respectively. The entropy at 298.15°K is 6.95 ± 0.04 cal/° kg atom.

539.2 : 532.7

ATOMIC VELOCITY DISTRIBUTIONS IN HgO. See Abstr. 6794

539.2 : 533.7

COLLISIONAL TRANSFER OF KINETIC ENERGY FROM A GAS ATOM TO A SOLID SURFACE. See Abstr. 6835

539.2 : 536.63

7853 ON THE SPECIFIC HEAT OF MnZn- AND NiZn-FERRITE BETWEEN 20°C AND 350°C.

J.L.Verhaeghe, G.G.Robbrecht and W.M.Bruynooghe.

Appl. sci. Res. B, Vol. 8, No. 2, 128-34 (1960).

Specific heat of $Mn_{1-a}Zn_aFe_2O_4$ (a ≅ 0.38) and $Ni_{1-a}Zn_aFe_2O_4$ (a ≅ 0.50) was measured with a Nernst adiabatic calorimeter. Associated with the ferrimagnetic transition, an enhanced specific heat, due to the magnetic contribution, is observed, having a maximum at the Curie point (172° and 308.5°C, respectively). The results of the measurements are tabulated and discussed.

539.2

7854 THERMAL EXPANSION OF GERMANIUM AT LOW TEMPERATURES. S.I.Novikova.

Fiz. tverdogo Tela, Vol. 2, No. 1, 43-4 (Jan., 1960). In Russian.

Dilatometric measurements were made of the thermal expansion of Ge between about 20° and 340°K. Below 48°K, the expansion coefficient is negative and reaches its minimum value of about -0.4×10^{-6}/°K at $T \cong 38°K$. The results are compared with those of Gibbons (Abstr. 3385 of 1959). R.F.S.Hearmon

539.2

7855 THE THERMAL EXPANSION ANOMALY OF GADOLINIUM. R.R.Birss.

Proc. Roy. Soc. A, Vol. 255, 398-406 (April 16, 1960).

The thermal expansion of polycrystalline gadolinium was measured from 80° to 750°K. The anomaly in the expansivity in the region of the ferromagnetic Curie point corresponds to an isotropic volume strain of 2.7×10^{-3}. The connection of the thermal expansion anomaly with the magnetostriction constants and the (hexagonal) magneto-elastic coupling constants is discussed.

539.2 : 536.41

7856 THERMAL EXPANSION OF TRIGLYCINE SULPHATE.

S.Ganesan.

Nature (London), Vol. 185, 757-8 (March 12, 1960).

Thermal expansion coefficients, measured by an interferometric method, are reported as a function of temperature between 0 and 90°C (1) parallel to the axis of spontaneous polarization b, and (2) parallel to the a and c axes, and perpendicular to the a axis. There is an abrupt change in sign of all coefficients at the transition temperature, the coefficient (1) changing from negative to positive, whereas the three coefficients (2) change from positive to negative. In the heating cycle, the transition takes place between 51 and 53°C, but on cooling it occurs at about 47°C. See also Abstr. 13218 (1959).
R.F.S.Hearmon

539.2

7857 LOW-TEMPERATURE TRANSPORT PROPERTIES OF COMMERCIAL METALS AND ALLOYS. II. ALUMINUMS.

R.L.Powell, W.J.Hall and H.M.Roder.

J. appl. Phys., Vol. 31, No. 3, 496-503 (March, 1960).

For previous work see Abstr. 5833 (1957). The thermal conductivity, electrical resistivity, Lorenz number, thermoelectric force, and thermoelectric power are given in the temperature range 4-120° K for ten aluminiums and aluminium alloys: high-purity, 1100-F, 1100-O, 3003-F, 2024-T4, 5052-O, 5083-O, 5086-F, 5154-O, and 6063-T5. Four of the samples show a maximum in thermal conductivity, the others do not. For the four high-thermal conductivity samples the separate components in the electronic thermal resistivity are resolved; for the others, components in both the electronic and the lattice thermal resistivities are given. The residual electrical resistivities vary from 2.5×10^{-8} to 3.2×10^{-6} ohm cm. The Lorenz numbers for the high-conductivity samples fall considerably below the Sommerfeld value 2.44×10^{-8} watt ohm/° K^2; those for the low-conductivity samples are somewhat above the Sommerfeld value. The thermoelectric power of some of the alloys is positive with respect to the high-purity sample, for others it is negative. The various properties, methods of analysis, and separation of components are discussed in detail.

539.2

7858 LOW-TEMPERATURE TRANSPORT PROPERTIES OF COMMERCIAL METALS AND ALLOYS. III. GOLD-COBALT. R.L.Powell, M.D.Bunch and E.F.Gibson.

J. appl. Phys., Vol. 31, No. 3, 504-5 (March, 1960).

For Pt II see preceding abstract. The thermal conductivity, electrical resistivity, and Lorenz number are given in the temperature range 4-100° K for the widely used thermocouple wire, gold 2.1 at.% cobalt alloy. The total thermal conductivity is relatively low: from 0.01 W/cm° K at 4° K to 0.23 at 100° K. The lattice contribution to the total thermal conductivity is larger than the electronic contribution. The electrical resistivity is nearly independent of temperature, but does have a definite minimum of about $1.20 \times$ $\times 10^{-5}$ ohm cm at 30° K. Because of the relatively large contribution of the lattice term to the total conductivity, the Lorenz number is considerably above the electronic Sommerfeld value, $2.44 \times$ $\times 10^{-8}$ W ohm/° K^2.

539.2

7859 THERMAL CONDUCTIVITIES OF FUSED AND CRYSTALLINE QUARTZ. E.H.Ratcliffe.

Brit. J. appl. Phys., Vol. 10, No. 1, 22-5 (Jan., 1959).

The thermal conductivities of fused quartz and of crystalline quartz (heat-flow at 90° to the optic axis) have been measured by steady-state plate methods; the former over the range -150 to 50°C, and the latter at 28°C. The most probable thermal conductivity values of these two materials have been formulated as functions of temperature, having in mind their use as calibration specimens for apparatus measuring the thermal conductivities of rocks, important in the calculation of terrestrial heat-flow. Detailed description is given of apparatus and measurement methods, and the results of other observers are listed and briefly discussed.

539.2

7860 THE THERMAL CONDUCTIVITY OF SILVER ANTIMONY TELLURIDE. E.F.Hockings.

J. Phys. Chem. Solids, Vol. 10, No. 4, 341-2 (Aug., 1959).

The total thermal conductivity of $AgSbTe_2$ was found to be 0.0071 watt $deg^{-1}cm^{-1}$ at 300° K. A value for the electronic contribution was estimated from the electrical conductivity as being 0.0008 watt $deg^{-1}cm^{-1}$, leaving a lattice contribution of 0.0063 watt $deg^{-1}cm^{-1}$ when other contributions were assumed neglibible. The specimens were p-type, non-degenerate semi-conductors with a face-centred cubic crystal structure having a = 6.076 A. The experimental technique was to place the samples between a heater and a sink, observing the temperature gradient for known heat flows and different specimen lengths. The experimental error was estimated at ±10% after correction was made for radiation losses from the heater and the specimen.

I.Cooke

539.2 : 536.21

7861 THE RATIO OF THE ELECTRON AND PHONON PARTS OF THE THERMAL CONDUCTIVITY IN STEELS. R.E.Krzhizhanovskii.

Zh. tekh. Fiz., Vol. 29, No. 4, 539-45 (April, 1959). In Russian. English translation in: Soviet Physics - Technical Physics (New York), Vol. 4, No. 4, 481-6 (April, 1959).

On the basis of experimental data, a study is made of the ratio of the electron and phonon conductivities. The effects on this ratio of the composition, temperature and heat-treatment are determined.

539.

7862 DYNAMICAL THEORY OF DIFFUSION IN CRYSTALS. IV. SOME ASPECTS OF THE INTRODUCTION OF IRREVERSIBILITY. S.A.Rice and H.L.Frisch.

J. chem. Phys., Vol. 32, No. 4, 1026-34 (April, 1960).

For Pt III, see Abstr. 4304 (1960). The origin of irreversibility in the phenomenon of crystal diffusion is examined from a dynamical point of view. It is shown that straightforward considerations lead to the establishment of two time scales, one for jumps between lattice sites and one for vibrations about a given lattice point. The dissipation of energy is shown to occur almost entirely by relaxation of "recaptured" particles, little energy being lost in the transit across the barrier. The quasi-equilibrium and nonequilibrium formulations are compared and shown to be quite similar in structure and functional dependenc

539.2

7863 CALCULATION OF THE HEAT OF SOLUTION OF COPPER IN GERMANIUM FROM DIFFUSION MEASUREMENTS. M.Tanenbaum.

J. chem. Phys., Vol. 32, No. 4, 1126-7 (April, 1960).

The diffusion of substitutional copper in germanium below 700° is explained by a dissociation mechanism proposed by Frank and Turnbull. It is shown that this mechanism provides a means for est mating the heat of solution of copper in germanium by measuring th activation energies for substitutional copper diffusion and for self-diffusion in germanium.

539.2

7864 ON THE TWO-PHONON SCATTERING OF X-RAYS IN ALUMINUM. N.Nilsson-Fröman.

Ark. Fys., Vol. 16, Paper 31, 329-35 (1960).

The contribution from the two-phonon processes to the intensity of diffuse X-ray scattering in crystals has been accurately calculated in the case of aluminium for three different directions of the scattering vector $\kappa = k-k_0$, where k_0 is the wave vector of the incident photon and k that of the scattered photon. The calculation is based directly on the dynamical equations for the lattice vibrations in the harmonic approximation. The only further approximation introduced is the assumption that the temperature is so high that the mean energy of every lattice vibration may be put equal to kT. Com parisons are made between this accurate calculation and different approximate calculations. This investigation is of interest for the determination of the frequency spectra of the lattice vibrations of crystals from the measured intensities of diffuse X-ray scattering.

539.2

7865 ULTRASONIC ABSORPTION IN METALS IN A MAG NETIC FIELD. I. V.L.Gurevich.

Zh. eksper. teor. Fiz., Vol. 37, No. 1(7) 71-82 (July, 1959). In Russian. English translation in : Soviet Physics — JETP (New York), Vol. 37(10), No. 1, 51-8 (Jan., 1960).

Ultrasonic absorption in metals at low temperatures and in a strong magnetic field (Larmor frequency of conduction electrons much higher than the collision frequency) is studied theoretically. A case is considered of an arbitrary law of energy dispersion of the electrons and of an arbitrary orientation of the field H relative to the axes of the crystal and the direction of sound propagation. It is found that the sound absorption coefficient Γ can experience two types of periodic variation with respect to 1/H : oscillations and increments (changes of a given sign which commence periodically). An expression is obtained for the periodic part of Γ for an arbitrary form of the collision operator. It is established that the experiment investigation of the increments permits the determination of the Gaussian curvature of the Fermi surface at all its elliptic points; a study of the oscillations permits the complete reconstruction of the Fermi surface if it possesses a centre of symmetry. See also the following abstract.

539.

7866 ULTRASONIC ABSORPTION IN METALS IN A MAGNETIC FIELD. II. V.L.Gurevich.

Zh. eksper. teor. Fiz., Vol. 37, No. 6, 1680-91 (Dec., 1959). In Russian.

Absorption of ultrasound in a metal located in a strong magnet field is considered, the Larmor radius of the conduction electrons being much smaller than the wavelength of sound. Various limiting cases corresponding to various relationships between these two lengths and the mean free path are studied. The absorption coefficie is calculated by simultaneously solving the kinetic equation and

Maxwell equations. It was found that there are two absorption mechanisms in a magnetic field. One of these, a deformation mechanism, leads to absorption also in the absence of a magnetic field. The absorption coefficient in this case can be expressed in terms of the deformation potential, that is, in terms of functions which determine the change in the electron energy caused by the deformation. At experimentally attainable ultrasound frequencies and in a strong magnetic field this relation is found to be quite simple in a number of cases. With satisfactory accuracy the magnitude of the deformation potential can be estimated on the basis of the absorption data. Induction absorption is due to electric fields which arise when a conductor deformed by the sound wave crosses magnetic lines of force. Absorption is determined by the Joule heat generated by the currents created by these fields. The induction absorption coefficient can be expressed in terms of certain combinations of the conductivity tensor components, with allowance for their time and spatial dispersion and the dependence on H. The asymptotic value of the conductivity tensor in a strong magnetic field with allowance for spatial dispersion was determined.

539.2 : 534.23

7867 EXCITATION AND ATTENUATION OF HYPERSONIC WAVES IN QUARTZ. H.E.Bömmel and K.Dransfeld.

Phys. Rev., Vol. 117, No. 5, 1245-52 (March 1, 1960).

A method for the generation and detection of hypersonic waves (i.e., frequency $> 10^9$ c/s), which has only been briefly described earlier (Abstr. 1177, 10715 of 1959), together with some absorption measurements in quartz, is discussed in some detail. Further measurements of the hypersonic absorption in quartz at different crystal orientations and after neutron irradiation are reported. The results are in qualitative agreement with a phonon—phonon relaxation process.

539.2

7868 BAND STRUCTURES AND SCATTERING MECHANISMS IN MONOCRYSTALLINE MERCURY SELENIDE AND MERCURY TELLURIDE. M.Rodot and H.Rodot.

C.R. Acad. Sci. (Paris), Vol. 250, No. 8, 1447-9 (Feb. 22, 1960). In French.

The crystals were grown by zone-melting in sealed tubes, the easy-growth direction being [111]. Measurements of magnetoresistance were made and together with previous thermomagnetic measurements were used to deduce the band structures. The conduction band in HgTe is probably isotropic and in HgSe is probably formed of 4 or 8 ellipsoids of revolution, centred on [100] directions. Carrier scattering is predominantly by acoustic phonons.

C.A.Hogarth

539.2

7869 STATISTICAL POTENTIAL FOR ACTINIDE METAL ENERGY BAND CALCULATIONS. G.W.Lehman.

Phys. Rev., Vol. 117, No. 6, 1493-6 (March 15, 1960).

A simple analytic potential energy function, V, is developed from a Thomas—Fermi ion model for the actinide metals and is found to provide good agreement with wave-functions derived from the Hartree self-consistent field approach by Ridley for the 5f, 6d, and 7s states of uranium. The estimated 5f, 6d, and 7s bandwidths are 1.1, 7.3, and 11.8 eV, respectively, in satisfactory agreement with those of Ridley. Dirac's equations are solved for the 5f, 6d, and 7s states using this nonrelativistic potential energy function with the Wigner—Seitz boundary condition. The relativistic energy shift for the 7s state is roughly 13 eV.

539.2

7870 ENERGY STATES OF A ONE-DIMENSIONAL CRYSTAL WITH VACANT LATTICE SITES. A.Mozumder.

Proc. Nat. Inst. Sci. India A, Vol. 24, No. 5, 288-94 (1958).

The effect of regularly spaced vacant sites (in an otherwise perfect one-dimensional crystal) on the electronic energy states has been investigated. The crystal model has been idealized by setting a δ-potential barrier at each occupied lattice point. Use has been made of the calculated energy levels in determining the percentage changes in electrical conductivity and low-frequency limit of the fundamental absorption band.

539.2

7871 ON THE THEORY OF INELASTIC SCATTERING OF ELECTRONS IN A SOLID BODY. A.Ya.Vyatskin.

Fiz. tverdogo Tela, Vol. 2, No. 1, 122-32 (Jan., 1960). In Russian.

The inelastic scattering of non-relativistic electrons by the electrons of a target material, earlier considered in the "weak-binding" approximation, is now considered for the case of strong binding. It is found wave-mechanically that the transitions arising from Coulomb interactions can be divided into two parts; one of these comprises inelastically scattered electrons which have experienced energy losses characteristic of the lattice. The "strong-binding" representation of these losses gives a fundamental picture of the mechanism of inelastic scattering.

A.E.I. Research Laboratory

539.2

7872 DETERMINATION OF THE EFFECTIVE ELECTRON MASS IN GaAs BY THE INFRA-RED FARADAY EFFECT.

T.S.Moss and A.K.Walton.

Proc. Phys. Soc., Vol. 74, Pt 1, 131-3 (July 1, 1959).

Measurements of free carrier Faraday rotation from 8 to 19 μ were made on three n-type single crystals. The mean effective mass was 0.072 m_0.

C.Hilsum

539.2 : 539.12

ENERGY LEVELS OF AN ELECTRON IN THE FIELD OF A FINITE DIPOLE. See Abstr. 5543

539.2 : 539.12

POSITRON LIFETIME IN ANTHRACENE AT TEMPERATURES NEAR THE MELTING POINT. See Abstr. 5549

539.2 : 539.19

7873 CALCULATION OF FRANCK—CONDON INTEGRALS. S.Koide.

Z. Naturforsch., Vol. 15a, No. 2, 123-8 (Feb., 1960).

A new method of approach is proposed for the problem of electronic transitions accompanied by the excitation of molecular or crystal vibrations. The Hamiltonian of the normal vibrations is expressed in terms of creation and annihilation operators, and the change in the equilibrium nuclear distances and vibrational frequencies are represented by transformations which are also expressed in terms of these operators. Calculations are made for some typical cases.

539.2

7874 EXCITON SPECTRA OF LiI AND ITS HYDRATES. F.Fischer and R.Hilsch.

Z. Phys., Vol. 158, No. 5, 553-62 (1960). In German.

Ruhl (Abstr. 2559-60 of 1956) has found that LiI condensed at 20°K crystallizes in a hexagonal structure whereas condensation at 20°C leads to the normal cubical structure. Corresponding differences are found in the optical behaviour. By condensing its vapour at 14°K, LiI is forced into an amorphous form. After reaction with H_2O, three different forms of LiI containing crystalline water are observed. Each of the exciton spectra of LiI and its hydrates contains a similar band doublet in spite of their diverse crystal structure. The doublet separation $\Delta h\nu$ depends on the spin—orbital interaction of the iodine p-electrons. It provides another test of the minimal condition $\Delta h\nu \geq 0.889$ eV given by Knox and Inchauspé (Abstr. 2810 of 1960).

539.2

7875 EXPERIMENTS ON CYCLOTRON RESONANCE IN GERMANIUM AND SILICON.

W.Mercouroff and J.C.Picard.

C.R. Acad. Sci. (Paris), Vol. 250, No. 11, 2010-12 (March 14, 1960). In French.

A brief description of apparatus for work at 36 kMc/s, and of preliminary results obtained.

R.G.Chambers

539.2

7876 CORRELATION BETWEEN CERTAIN EXTINCTION BANDS OF SOLIDS AND PLASMA RESONANCE.

B.R.Gossick.

J. appl. Phys., Vol. 31, No. 4, 650-1 (April, 1960).

A correlation is reported between certain optical extinction bands in sapphire, quartz, the silver and alkali halides and the calculated plasma resonance of electrons in colloidal particles which are either known or expected to be present. This correlation suggests not only that pile neutrons produce lithium particles in lithium fluoride, but aluminium particles in sapphire, and silicon particles in quartz.

Defect Properties

539.2

7877 STRUCTURAL DEFECTS IN FUSED AND CRYSTALLINE SILICA. W.C.Levengood.
Nature (London), Vol. 184, 1476-7 (Nov. 7, 1959).

Fractured surfaces are examined in each case, after suitable etching. In fused silica flaw patterns are found which may represent microcrystalline planes within the body of the material. In quartz the patterns are thought to represent a slip mechanism.

J.Thewlis

539.2 : 537.3 : 537.32

7878 ELECTRICAL CONDUCTIVITY AND THERMOELECTRIC POWER IN IONIC CRYSTALS. R.W.Christy.
Amer. J. Phys., Vol. 28, No. 5, 457-61 (May, 1960).

Many of the most interesting mechanical and electrical properties of solids, especially at high temperatures or after radiation damage, depend on the presence of point defects — interstitials and vacancies — in the crystal lattice. Ionic crystals are especially suited for the study of these defects, because in them the defects are electrically charged. The ionic conductivity mechanism is reviewed, with reference to the information it yields about the properties of the defects. Recently, further information about the defects has been derived from the thermoelectric power (Seebeck effect), and these new developments are summarized.

539.2

7879 DISTORTIONS IN METALLIC STRUCTURES. J.Graham.
Nature (London), Vol. 185, 29-30 (Jan. 2, 1960).

The slight distortions observed in the metallic structures of some metals such as indium, cadmium and zinc are interpreted in terms of an energy scheme whereby the Fermi energy is lowered as a result of the distortion. G.I.W.Llewelyn

539.2

7880 THE DEFORMABILITY OF NEIGHBOURING IONS. CONCERNING A NOTE IN THE WORK OF R.HOSEMANN: AN X-RADIOGRAPHICAL PROOF OF THE "POINT STRUCTURE" OF ELECTRONS. M.Balarin.
Z. Phys., Vol. 158, No. 1, 120-2 (1960). In German.

The term "polarization" is considered to be an inadequate one for describing the distortion of ions in distorted crystals.

A.R.Stokes

539.2

7881 LATTICE DISORDER AND PHYSICAL PROPERTIES CONNECTED WITH THE HYDROGEN ARRANGEMENT IN ICE CRYSTALS. H.Gränicher.
Proc. Roy. Soc. A, Vol. 247, 453-61 (Oct. 21, 1958).

The present knowledge of the hydrogen positions and of the physical properties sensitive to the hydrogen arrangement in ice crystals is reviewed. All possibilities of configurational changes in the ideal and the real crystal are considered. It is shown that the observed time-independence of the ionic conductivity leads to the conclusion that ions (H_3O^+ and OH^-) and Bjerrum defects (doubly-occupied and vacant bonds) must be present simultaneously. The concept that the hydrogen configurations are changed only by the diffusion of such defects proved to be the basis for a consistent theoretical explanation of the electrical, mechanical and nuclear relaxation phenomena and of the thermal properties.

539.3

7882 THE RECIPROCITY THEOREMS AND INFLUENCE FUNCTIONS FOR THE DISLOCATION DENSITY TENSOR AND FOR THE TENSOR OF INCOMPATIBLE DEFORMATIONS. V.L.Indenbom.
Dokl. Akad. Nauk SSSR, Vol. 128, No. 5, 906-9 (Oct. 11, 1959). In Russian.

The Maxwell's reciprocity theorem for residual deformations is reformulated here for elastic media whose stressed conditions are caused by some distribution of dislocations or of incompatible deformations; the influence function for dislocation corresponds here (in the new reciprocity theorem) to the stress function for a radial point force (in the usual formulation of that theorem). The author exemplifies the use of this reciprocity theorem by deriving Burger's equation for the unit dislocation loop in unbounded and in bounded media. J.K.Skwirzynski

539.

7883 EVIDENCE FOR DISLOCATION REACTIONS IN COPPER. F.W.Young,Jr and T.S.Noggle.
J. appl. Phys., Vol. 31, No. 3, 604-6 (March, 1960).

Observations of slip lines and etch pits at dislocations on a copper crystal hardened by irradiation and deformed by bending are interpreted in terms of dislocation reactions.

539.

7884 DISLOCATION MULTIPLICATION IN LITHIUM FLUORIDE CRYSTALS. W.G.Johnston and J.J.Gilman.
J. appl. Phys., Vol. 31, No. 4, 632-43 (April, 1960).

Experimental observations are presented of dislocation multiplication, of the defect structure left behind by a moving dislocation and of cross-glide of individual dislocations in LiF crystals. New dislocation loops form at many different sites in the wake of a movi dislocation. These loops have the same Burgers vector as the pare dislocation but do not, in general, lie on the same atomic plane. Th rate of formation of new loops depends upon the magnitude of the applied stress. Such creation of new loops leads eventually to the formation of a wide glide band. A moving screw dislocation trails many line defects behind it that lie parallel to its direction of motio The existence and nature of these trails and the observed dislocatio multiplication can be explained in terms of a mechanism which invo ves the formation, by cross-glide, of jogs on a screw dislocation. This cross-glide multiplication mechanism was originally proposed by Orowan and by Koehler (Abstr. 4677 of 1952). It is demonstrate that cross glide occurs easily in LiF, so that this mechanism is plausible. Some interesting complications arise when jogs are formed that are longer than several atomic spacings but less than several hundred. The defect trails exert a dragging of the screw dislocations that is not negligible compared to the yield stress of a crystal

539.

7885 BEHAVIOR OF INDIVIDUAL DISLOCATIONS IN STRAIN-HARDENED LiF CRYSTALS.
J.J.Gilman and W.G.Johnston.
J. appl. Phys., Vol. 31, No. 4, 687-92 (April, 1960).

The velocities of dislocations have been measured as a function of stress for both undeformed and deformed crystals. The motion is slower at a given stress in a strained crystal, and extra stress is needed to give the same velocity in a strained crystal as in one that is unstrained. It has been found that the extra stress is just equal to the difference in macroscopic flow stresses for the two states of a crystal. Existing theories of strain-hardening do not correctly predict the behaviour of LiF. Barrier-type theories are ruled out because the distance that a dislocation can move in a strain-hardene crystal does not seem to be limited. Theories of Taylor hardening or of cutting of a dislocation forest do not give the observed dependence of strain-hardening on dislocation density. It is observed tha the strain-hardening increment is proportional to the dislocation density (also to the plastic strain), and the proportionality constant 3-5 dynes/disl. The data are consistent with the idea that the hardening is due to defects left in the wakes of moving dislocations. These defects would interfere with the movement of subsequent dislocations on the same or nearby glide planes.

539.

7886 OBSERVATION OF DISLOCATIONS IN NON-METALLIC LAYER STRUCTURES. S.Amelinckx and P.Delavignett
Nature (London), Vol. 185, 603-4 (Feb. 27, 1960).

The electron microscope thin film transmission technique has been used to study dislocations in Bi_2Te_3, Sb_2Te_3, graphite, muscovite and talc. Within the resolution of the microscope available dislocations appear to be undissociated in Sb_2Te_3 with slight suggestio of dissociation in Bi_2Te_3. Extensive beam-induced movement of dislocations is observed both on the c-plane and on pyramidal glide planes. In muscovite the electron beam appears to cause gas bubbl to precipitate on dislocations. In graphite and talc dislocations are split into partials. In the latter the equilibrium separation is about 0.2 μ, corresponding to a very low stacking fault energy.

J.W.Mente

539.

7887 STACKING FAULTS IN ZINC. A.Fourdeux, A.Berghezan and W.W.Webb.
J. appl. Phys., Vol. 31, No. 5, 918-20 (May, 1960).

Configurations of individual dislocations in zinc have been studied by electron transmission microscopy and by X-ray diffraction microscopy. Loops of sessile dislocation have been observed surrounding stacking faults lying on (0001) planes. These loops were evidently formed by condensation of point defects. Changes in loop size with climb of the surrounding dislocation have been observed occurring in the electron microscope. Separation of glissile dislocations into partial dislocations separated by stacking faults on (0001) planes have also been observed. Various interactions among the several types of dislocation occur.

539.2

7888 ON THE BEHAVIOR OF THERMAL VACANCIES IN PURE ALUMINUM. D.K.Wilsdorf and H.G.F.Wilsdorf.

J. appl. Phys., Vol. 31, No. 3, 516-25 (March, 1960).

The results are reported of an investigation of quenched-in prismatic dislocation loops in super-purity aluminum. Some new effects have been observed: in particular, that loops tend to be grouped in clusters containing a surplus of loops of one orientation; that more than four loop orientations are realized; and that often pairs of similarly oriented and similarly shaped loops are present in the quenched material. It is concluded that vacancies aggregate into three dimensional clusters, containing from a few to a few hundred or even thousand vacancies, before being converted into prismatic loops.

539.2

7889 MULTIPLE TRAPPING SITES FOR HYDROGEN ATOMS IN RARE GAS MATRICES.

S.N.Foner, E.L.Cochran, V.A.Bowers and C.K.Jen.

J. chem. Phys., Vol. 32, No. 4, 963-71 (April, 1960).

Hydrogen atoms were stabilized in nonequivalent lattice sites in matrices of the rare gases at liquid helium temperature. Electron spin resonance spectra of H atoms in argon, krypton and xenon show that at least two trapping sites are involved in each case. In a neon matrix, H atoms were stabilized in only one site. Attainability of the various trapping sites apparently depends on the initial energy of the H atom, a simple doublet spectrum being obtained when the atoms are deposited from the gas phase, while multiple trapping spectra are obtained when the atoms are produced by photolysis in the solid. The hyperfine coupling constants and the electronic g factors for H atoms trapped in the various matrix sites were determined. The deviation of the hyperfine coupling constant from the free-state value is positive in some cases and negative in others. The experimental results are in good agreement with theoretical predictions. A complex multicomponent H atom spectrum was obtained by photolysis of HI in xenon. The subsplitting in the spectrum is attributed to magnetic hyperfine interactions with matrix nuclei (Xe^{129} and Xe^{131}). The nature of the trapping sites in rare gas matrices is discussed. Evidence for trapping in substitutional sites and octahedral sites is presented.

539.2

7890 MATRIX EFFECTS ON THE ELECTRON SPIN RESONANCE SPECTRA OF TRAPPED HYDROGEN ATOMS.

F.J.Adrian.

J. chem. Phys., Vol. 32, No. 4, 972-81 (April, 1960).

A study is made of the matrix effects on the electron spin resonance spectra of hydrogen atoms stabilized in nonpolar matrices. It is assumed that the perturbing effect of the matrix consists of van der Waals interactions and the overlap or Pauli exclusion forces. These two effects are treated separately and the results added to get the net result. The van der Waals effect, which is treated by perturbation theory, leads to a reduction in the h.f.s. splitting. The overlap effect, which is treated by requiring that the hydrogen atom wave-function be orthogonal to the wave-functions of the matrix particles, leads to an increase in the h.f.s. splitting. In addition, the exclusion effect tends to introduce a small amount of the unpaired electron charge density onto the matrix particles. This can lead to a change in the electronic g-factor, and also to hyperfine interactions with the nuclei of the matrix particles. The theory gives a good qualitative picture of the various matrix effects and their dependence on various properties of the matrix atoms and molecules.

539.2 : 536.49

7891 EVAPORATION FIGURES ON THE SURFACE OF SODIUM CHLORIDE CRYSTALS.

G.Turchányi and T.Horváth.

Nature (London), Vol. 185, 601-2 (Feb. 27, 1960).

NaCl crystal plates, heated close to the melting point for 4-5 days, showed contours which might be due to Frank-Read sources. J.Franks

539.2

7892 SPECIFIC IONIZATION MEASUREMENTS AND ENERGY REQUIREMENTS FOR F-CENTER FORMATION.

R.D.Jordan and R.S.Alger.

J. appl. Phys., Vol. 31, No. 5, 747-52 (May, 1960).

Measurements were made of the energy required to produce F-centres in pure and sensitized alkali halide crystals by bombardment with electrons and deuterons accelerated in a Van de Graaff generator. In KBr + KH exposed to 1.2 MeV electrons, 35 eV were required per F-centre. This value is in agreement with other published data. A value of approximately 100 eV was required with deuterons and KBr + KH. Slightly lower yields were found for several other salts. The specific ionizations of electrons, deuterons, and γ-rays were investigated and used to determine the accelerator beam size and penetration. The ranges of electrons in KBr, KCl, and NaCl were measured as a function of accelerator voltage and found to agree well with ranges predicted by the Feather rule. Energy transport and features of the specific ionization pattern are discussed in terms of the Seitz synthesis of crystal imperfections.

539.2

7893 THERMAL EQUILIBRIUM BETWEEN F AND M CENTRES IN POTASSIUM CHLORIDE. C.Z.van Doorn.

Phys. Rev. Letters, Vol. 4, No. 5, 236-7 (March 1, 1960).

It is shown from experiments on additively coloured crystals that the M-centre concentration varies quadratically with F-centre concentration. This result supports the theory that M-centres are formed by associated pairs of F-centres (Abstr. 5994 of 1957) but not that of Knox (Abstr. 5161 of 1959) involving an F-centre associated with a neutral vacancy pair. G.F.J.Garlick

539.2

7894 F-BAND STRUCTURE IN CESIUM BROMIDE.

H.Rabin and J.H.Schulman.

Phys. Rev. Letters, Vol. 4, No. 6, 280-2 (March 15, 1960).

The optical absorption spectra from 350 to 750 mμ at room and liquid He temperature were measured for two single CsBr crystals, one additively coloured with K, and the other irradiated with X-rays. The absorption spectra for the two crystals are very similar, and are evidently due to F-centres. J.Franks

539.26

7895 SOME OBSERVATIONS CONCERNING THE EFFECT OF IMPURITIES ON THE ANATASE—RUTILE TRANSITION.

C.N.R. Rao, A.Turner and J.M.Honig.

J. Phys. Chem. Solids, Vol. 11, No. 1-2, 173-5 (Sept., 1959).

5 at. % impurities Sb^{5+}, Al^{3+}, Zn^{2+}; PO_4^{3-}, SO_4^{2-} and Cl^- were added to pure TiO_2. Percentages of anatase—rutile transformations at various temperatures were established from measurements of X-ray diffraction line intensities. The Sb-doped sample could not be studied because of volatalization. All the impurities investigated had an adverse effect on transition i.e. they stabilized the anatase structure. The degree of stabilization is in the order $Zn^{2+} < Al^{3+}$ for cations and $Cl^- < SO_4^{2-} < PO_4^{3-}$ for anions. The rates of conversion appear to follow the second-order law as in pure samples. J.Adam

539.2

7896 THE FLOW OF IMPURITIES TO AN EDGE DISLOCATION.

R.Bullough and R.C.Newman.

Proc. Roy. Soc. A, Vol. 249, 427-40 (Jan. 13, 1959).

The number of impurity atoms arriving at an edge dislocation has been calculated as a function of time, making due allowance for core saturation due to back diffusion and depletion. Initially the variation agrees closely with the previously calculated dependence of $(\text{time})^{2/3}$, while at large times a steady state is achieved. The theory is in excellent agreement with experiments on the strain ageing of some low carbon steels over the complete range of time.

539.2

7897 RELATIVE ENERGIES OF TILT-TYPE SUBBOUNDARIES IN ALUMINUM. K.T.Aust.

Canad. J. Phys., Vol. 38, No. 4, 547-54 (April, 1960).

The relative energies of subboundaries were obtained, in terms of a reference large-angle grain boundary, in aluminium bicrystals having two different effective impurity concentrations. The data for subboundary energy versus subgrain orientation difference (θ) showed a cusp at $\theta \cong 0.75^\circ$. The existence of such a cusp was previously predicted by Martius and Chalmers (1952) from considerations of impurity effects at boundaries.

539.2

7898 GRAIN BOUNDARIES IN GERMANIUM.
R.S.Wagner and B.Chalmers.

J. appl. Phys., Vol. 31, No. 3, 561-7 (March, 1960).

The relative energies and the boundary orientations of simple tilt boundaries in germanium crystals have been measured. The measurements were made on columnar tricrystals prepared by the modified Czochralski method. The orientations of the columnar tricrystals were either ⟨100⟩ and ⟨111⟩ isoxial or (100) isoplanar. The relative grain boundary energies were measured as a function of the angular misorientation θ between two grains. The crystallographic orientations of the grain boundary plane were also determined. It was found that the relative energy of ⟨100⟩ and ⟨111⟩ tilt boundaries up to about 15° of misorientation changes with misorientation as predicted by Read and Shockley's theory (Abstr. 7592 of 1950). For larger angles of misorientation, the grain boundary energy is essentially independent of the angle of misorientation. This indicates a significant but continuous change in boundary structure at the transition region. Additional evidence for the difference in the structure of low- and high-angle tilt boundaries was found in the apparent strong dependence of the energy of low-angle boundaries on the boundary orientation. Low-angle (100) twist boundaries were not observed.

539.2

7899 MODELS OF GRAIN BOUNDARIES IN THE DIAMOND LATTICE. I. TILT ABOUT ⟨100⟩. J.Hornstra.

Physica, Vol. 25, No. 6, 409-22 (June, 1959).

Small-angle grain boundaries are known to consist of arrays of dislocations. It is shown that in the diamond lattice not only for small, but for all angles of tilt about $[1\bar{1}0]$ a dislocation model can be constructed. There are no abrupt changes of model for small variations of the angle of tilt and the {111} twin boundary comes out automatically. This twin boundary can equally well be described as a twist boundary with a network of screw dislocations, but both models are identical with the generally accepted structure of the {111} twin boundary.

539.2

7900 OPTICAL STUDY OF THE DIFFUSION OF OXYGEN IN THE GLASSY NON-STOICHIOMETRIC GERMANIUM OXIDE. V.G.Canina and J.Denoncin.

C.R. Acad. Sci. (Paris), Vol. 250, No. 10, 1815-17 (March 7, 1960). In French.

The progressive disappearance of an absorption band around 2450 A (Abstr. 10286 of 1959) found in such oxides formed at high temperatures (1400-1500° C) as a consequence of heating in oxygen is reported. The band disappears as the oxide film takes up oxygen by diffusion via anion vacanies, the activation energy for the process being 1.2 eV. W.Bardsley

539.2

7901 GRAIN BOUNDARY AND LATTICE DIFFUSION IN POLYCRYSTALLINE BODIES.
H.S.Levine and C.J.MacCallum.

J. appl. Phys., Vol. 31, No. 3, 595-9 (March, 1960).

Diffusion in a polycrystalline body is discussed under the assumption that two interrelated mechanisms consisting of diffusion through the grains and in the boundaries around the grains are dominant in different penetration regions. The general behaviour of the average concentration-distribution of diffusant is described for the separate action of each mechanism, and the effects of their combined action are inferred. A realistic diffusion model for a polycrystalline body and a suitable empirical function to describe the loss of diffusant from the boundaries to the grains form the basis for these computations. Results are specifically applied to the analysis of the usual sectioning technique for measuring the ratio of grain boundary to lattice diffusion constants in a polycrystalline body. It is shown that, in the penetration range most commonly covered in polycrystalline diffusion experiments, the log of the average concentration varies as the 6/5 power of penetration depth contrary to the linear law reported previously. Comparison is made between the present and previous methods for establishing the grain boundary diffusivity of silver. The results are found to differ by a factor of 3 or 4. Criteria for validity of the method associated with the relative magnitudes of reduced time, grain size, and the ratio of grain boundary to lattice diffusion constants are established. Some of the results reported for Zn and Cd do not satisfy these criteria.

539.

7902 ON THE CHARACTERISTIC DISTURBANCE OF AGEING IRON DURING IONIC BOMBARDMENT.
A.Mašín and V.Havel.

Acta phys. Hungar., Vol. 10, No. 2, 135-47 (1959). In German.

During the ionic bombardment of iron, slip lines became visible which had attracted C and N atoms during the ageing process. The significance of glide lines and impurity atoms in the kinetics of ageing after hardening is discussed. J.Franks

539.

7903 LATTICE DISPLACEMENTS BY FAST ELECTRONS.
W.D.Compton and G.W.Arnold.

J. appl. Phys., Vol. 31, No. 4, 621-5 (April, 1960).

A discussion is given of the processes by which atoms are displaced from their lattice sites by incident fast electrons. In additio to direct displacement by the incident electron, expressions are derived for the fraction of atoms displaced by fast moving atoms and b fast secondary electrons, both of which are generated initially by th incident electron. A discussion of thermal spikes is given. A thermal spike process is discussed that might lead to the generation of defects with X-irradiation in materials that exhibit a threshold energy for a displacement by a charged particle.

539.

7904 EFFECT OF ATOMIC INTERACTION POTENTIAL ON DEFECT PRODUCTION IN METALS.
E.Brown and G.H.Goedecke.

J. appl. Phys., Vol. 31, No. 5, 932-4 (May, 1960).

The cascade of displaced atoms in metals, induced by high energy radiation, has been investigated, with the assumption of a screened Coulomb interaction between atoms. The problem was treated stochastically on an IBM 650 electronic computer for several different models. The comparison of the results with those for which a hard sphere interaction has been used shows only a slight decrease in the expected number of atomic displacements.

539.2

7905 THE EFFECTS OF NEUTRON IRRADIATION ON THE PROPERTIES OF IRON AND STEELS. D.R.Harries.

J. Iron Steel Inst., Vol. 194, Pt 3, 289-304 (March, 1960).

The principal mechanisms of radiation damage in non-fissile metals are summarized and the terms used in irradiation experiments defined. Neutron irradiation effects on the mechanical proper ties of single and polycrystalline pure iron are described and the effects on the properties of ferritic and austenitic steels are detaile The extent to which the exchange in mechanical properties are affected by irradiation and metallurgical variables are reviewed. Results on the annealing of radiation damage are considered and the available data on the mechanism of the radiation embrittlement surveyed. The most important topics which need further study are summarized.

539.

7906 IRRADIATION DAMAGE AND RECOVERY IN MOLYBDENUM AND TUNGSTEN.
G.H.Kinchin and M.W.Thompson.

J. nuclear Energy, Vol. 6, No. 4, 275-84 (May, 1958).

Specimens of molybdenum and tungsten have been irradiated with pile neutrons at 30° C and at −196° C. The recovery of the increase in resistivity has been studied and processes have been observed with activation energies of 0.25 and 1.3 eV for molybdenum and with 0.5 and 1.7 eV for tungsten. A stored energy release of 0.4 cal/g from 50° C to 250° C has also been observed from molybdenum irradiated with 1.3×10^{19} n/cm^2.

539

7907 ELECTRON MICROSCOPIC EXAMINATION OF NEUTRON IRRADIATED LiF-CRYSTALS.
E.Schüler and J.Schepers.

Physica, Vol. 25, No. 6, 487-8 (June, 1959).

Secondary etch pits were produced in an etched LiF crystal aft irradiation with a dose of 9×10^{17} thermal n/cm^2. Wrinkles occurred in crystals irradiated with doses above 2.5×10^{17} therma n/cm^2. J.Frank

ELECTRICAL PROPERTIES OF SOLIDS

(Superconductivity is included under Low-Temperature Physics)

539.2 : 537.3

7908 ELECTRICAL RESISTIVITY PROPERTIES OF NOBLE METAL ALLOYS. J.O.Linde.

Physica, Vol. 24, Supplement, S109-S117 (Sept., 1958).

Low Temperature Physics Conference (see Abstr. 7017 of 1960). The temperature dependence of the resistivity of alloys at low and middle high temperatures and the influence of elastic and plastic deformation on the resistivity at normal temperatures are reviewed. The theoretical background of the observed resistance effects is discussed in the light of the paramagnetic properties of the alloys. The review makes clear that in many cases correlations exist between the different effects studied at high and at low temperatures.

539.2 : 537.3 : 537.311

7909 A NOTE ON THE RESISTIVITY OF LIQUID ALKALI AND NOBLE METALS. N.Cusack and J.E.Enderby.

Proc. Phys. Soc., Vol. 75, Pt 3, 395-401 (March, 1960).

Resistivity values, and some absolute thermoelectric powers, for pure metals and semiconductors at and above the melting point are collected and tabulated. Theories of the change in resistance on melting are discussed in relation to the subdivision of the melting entropy into vibrational and structural parts.

539.2 : 537.3

7910 TEMPERATURE-DEPENDENCE OF THE ELECTRICAL RESISTIVITY OF B.C.C. Cr—Fe ALLOYS.

N.S.Rajan, R.M.Waterstrat and P.A.Beck.

J. appl. Phys., Vol. 31, No. 4, 731-2 (April, 1960).

The electrical resistivity v. temperature was determined for a b.c.c. Cr + 20 at. % Fe alloy from 4.2° to 300°K. The absence of any discontinuity in this curve indicates that the very high temperature-coefficient of the linear term of the specific heat previously found at that composition is not associated with a phase transformation between room temperature and 4.2°K. For b.c.c. Cr-alloys with Fe contents increasing from 0 to 16 at. % Fe the resistivity v. temperature anomaly shifts from approximately 308°K to progressively lower temperatures, and the anomalous resistivity increase with decreasing temperature becomes progressively larger. It is quite possible that these anomalies are connected with antiferromagnetic-paramagnetic transition in the alloys considered.

539.2 : 537.3

7911 ELECTRICAL CONDUCTIVITY OF THIN FILMS OF GOLD DEPOSITED ON A SUBSTRATE OF SILICON.

H.Damany.

C.R. Acad. Sci. (Paris), Vol. 250, No. 9, 1615-17 (Feb. 29, 1960). In French.

The conductivity of these layers is very sensitive to the ambient gas atmosphere so that deviations from Ohm's law are observed even at room temperature. The silicon substrate serves two purposes: (1) favours the adherence of gold and reduces granularity; and (2) acts as a conducting bridge between the granular aggregates of the gold. C.A.Hogarth

539.2 : 537.3

7912 LOW TEMPERATURE RESISTANCE AND MAGNETO-RESISTANCE OF DILUTE ALLOYS OF GOLD WITH COBALT. A.N.Gerritsen.

Physica, Vol. 25, No. 6, 489-502 (June, 1959).

The measurements of the resistance and magneto-resistance at low temperatures of dilute alloys of gold with cobalt (up to 0.44 at.%) demonstrate that striking anomalous effects are absent in the relations between resistance, magneto-resistance and temperature or magnetic field. The influence of the transition metal, however, is observable as small deviations from a normal resistance temperature curve. The Kohler relation for the magneto-resistance fails for the larger cobalt concentrations. A survey of the available experimental data on alloys of this kind, including magnetic properties, is given.

539.2 : 537.3

7913 TOPOLOGY OF THE FERMI SURFACE OF GOLD. Yu.P.Gaidukov.

Zh. eksper. teor. Fiz., Vol. 37, No. 5 (11), 1281-9 (Nov., 1959).

The resistance anisotropy of gold single crystals in a magnetic field was determined. It was found that for certain directions of the magnetic field relative to the crystallographic axes of the single crystals the resistance varies according to a quadratic law, whereas for other directions it completely saturates in fields $H \gg H_0$. It can thus be concluded that an open-Fermi surface exists in gold. A stereographic projection of preferred directions of the magnetic fields was constructed, and an analysis of it shows that the Fermi surface in gold is a "spatial network" produced by "corrugated cylinders", the axes of which are parallel to the directions [110] and [111] of the reciprocal lattice. The resistance of gold single crystals was averaged over the angles. The magnitude of the averaged resistance depends linearly on the magnetic field, thus explaining Kapitza's law.

539.2 : 537.3

7914 THE ELECTRICAL RESISTIVITY OF THE TWO PHASES OF SODIUM AT LOW TEMPERATURES.

J.S.Dugdale and D.Gugan.

Proc. Roy. Soc. A, Vol. 254, 184-204 (Feb. 9, 1960).

At low temperatures the crystal structure of sodium changes by the martensitic mechanism from body-centred cubic to close-packed hexagonal. By measurements on specimens which partially transform on cooling and by measurements on specimens whose composition has been changed by suitable straining, the resistivity of the two phases has been approximately determined between 15° and 50°K. The hexagonal close-packed phase has a lower ideal resistivity than that of the body-centred cubic phase (by about 40% at 20°K), whereas the residual resistivity is effectively independent of the structure. Some theoretical implications are discussed.

539.2 : 537.3

7915 ON THE THEORY OF THE ELECTRICAL CONDUCTIVITY OF ANTIFERROMAGNETIC CRYSTALS.

M.Sh.Giterman and Yu.P.Irkhin.

Fiz. tverdogo Tela, Vol. 2, No. 1, 144-52 (Jan., 1960). In Russian.

Account is taken of both spin ordering and lattice vibrations. In the model assumed, metal ions constitute two sub-lattices with anti-parallel moments determined by d-bands. Metalloid ions have closed shells and only influence conductivity through indirect exchange. There is one electron at each metal lattice site with a less-localized wave function than a d-electron. It is shown that there should be related jumps in the activation energy and the logarithm of conductivity at the Néel point. If the former is positive the latter can be of either sign, but is positive and at least $\Delta E/kT_N$ for ΔE negative. Agreement with experiments on NiO is inconclusive. $\Delta E < 0$ has been found (Volchenkova and Pal'guev, 1958) with no jump in $\ln \sigma$; it is suggested that this ΔE may not be related to magnetic ordering but to the transition from impurity to intrinsic conductivity. Also $\Delta \ln \sigma$ has been observed as 0.5 (Shimanura and Tsubokawa, 1958), corresponding to $\Delta E \sim 0.1$ eV. R.Berman

539.2 : 537.3

7916 IONIC CONDUCTIVITY OF ZONE REFINED ALKALI HALIDES. H.Gründig.

Z. Phys., Vol. 158, No. 5, 577-94 (1960). In German.

KBr and KCl crystals were purified by zone refining, using either fused quartz or graphite crucibles. The extrinsic ionic conductivity of the purified material was lowered by a factor of 200 for KBr and 1000 for KCl. The residual content of divalent ions is of the order of 10^{-8} to 10^{-9}. The detailed temperature dependence of the extrinsic conductivity suggests an association of the divalent ions with cation vacancies at lower temperatures. The binding energy for these complexes is: 0.52 ± 0.04 eV in KCl, and 0.56 ± 0.04 eV in KBr for Ca^{++}-impurities. From the temperature dependence of the extrinsic conductivity in very pure material, the activation energy for the vacancy mobility can be estimated as 0.77 ± 0.02 eV for KCl, and 0.65 ± 0.02 eV for KBr.

539.2 : 537.3 : 539.3

7917 ELECTRICAL EFFECTS DURING CYCLIC STRESSING OF SODIUM CHLORIDE. S.Amelinckx, J.Vennik and

S.Amelinckx, J.Vennik and G.Remaut.

J. Phys. Chem. Solids, Vol. 11, No. 1-2, 170-1 (Sept., 1959).

A crystal plastically deformed in pure shear has superposed a small-amplitude mechanical vibration (10-100 c/s); the induced potential on a gold surface electrode is displayed on a c.r.o. The effect is ascribed to motion of dislocations from their surrounding Debye—Hückel cloud of vacancies. J.E.Caffyn

539.2 : 537.3

7918 BOMBARDMENT CONDUCTIVITY AND PHOTOCONDUCTIVITY IN RHOMBIC SULPHUR.

P.J.Dean, B.S.H.Royce and F.C.Champion.

Proc. Phys. Soc., Vol. 75, Pt 1, 119-35 (Jan., 1960).

Using pure single crystals of rhombic sulphur, of volume a few mm^3, conduction counting occurs for α-particle bombardment but only in a region close to the negative electrode, indicating a barrier effect. If the applied voltage is increased there is an increase in the counting rate proportional to V^n where $n = 0.7$, but no increase in the maximum pulse height. Creation of a space-charge barrier is essential before counting can begin, after which the counting rate decays with time but the crystal can be reactivated by light or other ionizing radiations. Examination was made of the primary photoconductivity between 4400 A and 9000 A, down to 130°K and the photoconductive efficiency was found to be about 1.5 μAW^{-1}. Comparing these results with von Hippel's interpretation for the alkali halides, a mean value of $N = 10^{13}$ cm^{-3} was obtained for the donor density. Secondary currents were also observed and breakdown pulses were attributed to field emission at the electrodes. The free path ω per unit field was estimated as $\geq 5 \times 10^{-8}$ cm, and the lower limit of the mobility μ_e of the electrons, which were the charge carriers, as about 10^{-1} $cm^2 v^{-1} sec^{-2}$. The energy per ion pair was found experimentally to be about 32 eV which agrees with the value deduced from independent data on the electronic band structure of sulphur. The thickness of the barrier layer was approximately 10^{-2} cm with barrier field strength of the order of 10^5 v cm^{-1}. The conductivity pulse magnitude depends upon the position of the α-particle track inside the barrier and the excitation mechanism for conductivity pulses in a molecular crystal like sulphur differs considerably from that of a covalent crystal like diamond.

539.2 : 537.3 : 537.32

INFORMATION ON DEFECTS IN IONIC CRYSTALS FROM CONDUCTIVITY — A REVIEW. See Abstr. 7878

Semiconductors

539.2 : 537.311

7919 LOCATION OF P—N AND L—H JUNCTIONS IN SEMICONDUCTORS. P.A.Iles and P.J.Coppen.

Brit. J. appl. Phys., Vol. 11, No. 5, 177-84 (May, 1960).

The properties of p—n and l—h junctions are summarized and the methods which have used these properties to locate the junctions are discussed. Critical comments are made and criteria are given which must be considered when choosing a method, and some methods are recommended for the elements germanium and silicon. Lastly, an idea is given of the range of useful understanding of semiconductors which has resulted from use of these methods.

539.2 : 537.311

7920 CALCULATION OF THE ELECTRICAL CONDUCTIVITY OF A SEMICONDUCTOR WITH HIGH CONCENTRATION OF IMPURITIES. R.Zigenlaub.

Dokl. Akad. Nauk SSSR, Vol. 117, No. 3, 395-8 (1957). In Russian.

The kinetic equation method is severely limited in its application by its limited relaxation time range. This excludes for example the low-temperature range and high impurity concentrations if carrier scattering on charged impurities occurs. The author bases calculations therefore on the method suggested by Nakano, Kubo and Tomita (Abstr. 2881 of 1955, 8765 of 1956), not requiring the kinetic equation. The calculations are simplified by the introduction of approximate δ-functions.

539.2 : 537.311

7921 AN INVESTIGATION OF CERTAIN "LONG" DIODE PROPERTIES. S.A.Kramareva and V.I.Stafeev.

Fiz. tverdogo Tela, Vol. 2, No. 2, 377-9 (Feb., 1960). In Russian.

The current-voltage characteristics of these diodes (so-called, because of their diffusion lengths; see Abstr. 13311 of 1959) is studied as a function of temperature. For most temperatures a negative resistance region is observed, which vanishes when the temperature is raised sufficiently. The form of the observed temperature variation, which also obtains for Au-doped Ge diodes, is explained by the reduction in diffusion length with temperature. For certain diodes, no negative resistance was observed for temperatures down to −195° C. In these diodes, for which the lifetimes decrease as the injection level is raised, a negative photoeffect is observed whe the photocurrent for a given voltage may be less than the dark curr a mechanism for this is suggested. V.V.Zakharo

539.2 : 537.31

7922 ANALYSIS OF LOW-LEVEL SEMICONDUCTOR LIFETIME DECAY WAVESHAPES. J.Mandelkorn.

Rev. sci. Instrum., Vol. 30, No. 4, 455 (April, 1960).

539.2 : 537.3

7923 FARADAY EFFECT IN SEMICONDUCTORS WITH FRE CARRIERS IN A STRONG MAGNETIC FIELD.

L.É.Gurevich and I.P.Ipatova.

Zh. eksper. teor. Fiz., Vol. 37, No. 5 (11), 1324-9 (Nov., 1959). In Russian.

The permittivity tensor is determined for an electron with an anisotropic mass in a strong magnetic field. The Faraday effect is considered for the case of hexagonal crystals with an energy minimum in the centre of the Brillouin zone and also for a cubic crysta with a minimum which does not coincide with the centre of the Brillouin zone. The refractive indices calculated for various directions in the crystals are found to depend strongly on the direction o the magnetic field. This circumstance permits one to determine th components of the effective mass tensor by measuring the angle of rotation of the plane of polarization.

539.2 : 537.311 : 539.

THEORETICAL STUDY OF ADHESION PHENOMENA BETWEEN AN N-TYPE SEMICONDUCTOR AND A METAL. See Abstr. 4574

539.2 : 537.31

7924 STUDY OF RECOMBINATION AND GENERATION PHENOMENA IN GERMANIUM P_0—N_0 JUNCTIONS.

M.Bernard.

Ann. Telecomm., Vol. 15, No. 1-2, 2-26 (Jan.-Feb., 1960). In Frenc

The experimental data cannot be explained by the original Shockley-Read model alone, and generation within the depletion laye is invoked in conjunction with the effect of recombination centres each having two energy levels. The theory is developed in detail an is found to be in agreement with the results of Sah and Shockley (Abstr. 1678 of 1958). The experimental work, including the prepar tion of junctions containing defined recombination centre densities and types, is reported in detail and the data interpreted in terms of the new theory. F.F.Roberts

539.2 : 537.311

7925 THE TEMPERATURE DEPENDENCE OF LOW FREQUENCY CONDUCTIVITY FLUCTUATIONS IN GERMANIUM. M.I.Kornfel'd and D.N.Mirlin.

Fiz. tverdogo Tela, Vol. 1, No. 12, 1866-8 (Dec., 1959). In Russian.

Measurements are briefly described and temperature curves ar shown, e.g. for samples with different impurity concentrations and with different surface treatments. The results show that l.f. fluctuations are inherent in the self conductivity in reasonably perfect Ge crystals and are connected with the generation and recombinatio of electron-hole pairs. D.E.Brown

539.2 : 537.311

7926 THEORY OF THE ANISOTROPIC PHOTOMAGNETIC EFFECT IN GERMANIUM. A.A.Grinberg.

Fiz. tverdovo Tela, Vol. 2, No. 1, 153-6 (Jan., 1960). In Russian.

In a magnetic field the anisotropy of the conductivity leads to the direction of the ambipolar current being different from that of the concentration gradient. This is developed theoretically and foun to agree with the results of Kikoin and Bykovskii for a Ge crystal illuminated on the (111) plane and rotated about the (111) axis by an angle φ. The photomagnetic e.m.f. is found to be proportional to $H^2(\frac{4}{3}\cos^2\varphi - 1)\cos\varphi$. It is predicted that the ordinary photomagnetic effect should have an additional term proportional to $H^2(\frac{4}{3}\sin^2\varphi - 1)$sin

D.J.Huntley

539.2 : 537.311

7927 INTERACTION OF WATER VAPOUR WITH GERMANIU REAL SURFACE. K.Kawasaki, K.Kanou and Y.Sekita.

J. Phys. Soc. Japan, Vol. 14, No. 2, 233-4 (Feb., 1959).

The density of absorbed water molecules is found to be critical when considering whether the resistance is to increase or decrease when water is absorbed on an n- or p-type Ge surface etched with CP4 solution. The effect of water vapour saturates for values of surface coverage lying between 5×10^{-3} and 8×10^{-3}.

C.A.Hogart

539.2 : 537.311

7928 FIELD EMISSION IN GERMANIUM.
T.Hayashi.

J. Inst. Elect. Commun. Engrs Japan, Vol. 42, No. 12, 1180-6 (Dec., 1959). In Japanese.

Phenomena analogous to field emission in vacuum tubes have been found in diodes of the n—ν—m and p—ν—m types when reverse voltage is applied, ν denoting a thin layer of germanium which has nearly intrinsic resistivity, while m denotes a tungsten wire point contact to the Ge layer. The current/voltage characteristics are represented by the equation $I = A \exp(-B/V)$, where I is the emitted current, V the reverse voltage and A and B are constants. The currents are found to be independent of temperature in the range from 70° to +40° C. The emission mechanism involved in these phenomena is discussed by means of energy-level diagrams and it is shown that the injection mechanism of carriers into a space-charge layer of a semiconductor p—n junction, as in the case of spacistors or depletion—layer transistors, can be explained in a similar manner.
A.Wilkinson

539.2 : 537.311

7929 ORIGIN OF THE PHOTOMAGNETISM ANOMALY IN GERMANIUM. A.R.Moore and J.O.Kessler.

Phys. Rev. Letters, Vol. 4, No. 3, 121-3 (Feb. 1, 1960).

Experiments are described, which suggest the presence of excitons in germanium in sufficient concentration to give rise to an anomalously large change in diamagnetic susceptibility under illumination by tungsten light.
C.A.Hogarth

539.2 : 537.311

7930 FAR INFRARED ELECTRON-IONIZED DONOR RECOMBINATION RADIATION IN GERMANIUM.
S.H.Koenig and R.D.Brown,III.

Phys. Rev. Letters, Vol. 4, No. 4, 170-3 (Feb. 15, 1960).

100μ radiation resulting from the recombination of "hot" electrons in the conduction band with ionized donor impurities was detected, at 4.2° K, by observing photoconduction in a second sample of Ge exposed to the radiation. Since a Sb doped generator can induce photoconductivity in an As doped detector (with a higher activation energy), the radiation must be due to recombination of reasonably "hot" electrons (~10 kT).
L.Pincherle

539.2 : 537.311

7931 THE DISTRIBUTION IN RELAXATION TIME OF SLOW TRAPS ON SILICON AND GERMANIUM SURFACES.
I.Abkevich.

Dokl. Akad. Nauk SSSR, Vol. 127, No. 6, 1199-202 (Aug. 21, 1959). In Russian.

The variation with time of surface contact potential is obtained from theoretical calculations based on a continuous distribution of relaxation times (Abstr. 7410 of 1956) and is compared with experimental results (see also Abstr. 1637 of 1960) on variously treated surfaces. After bombardment with slow electrons an exponential variation was obtained, in good agreement with the theory; it is noted that this cannot be explained in terms of monoenergetic traps, and that a continuous distribution also gives an explanation of 1/f noise.
C.H.L.Goodman

539.2 : 537.311

7932 VOLUME RECOMBINATION IN P-TYPE SILICON SUBJECTED TO HEAT TREATMENT AT HIGH TEMPERATURES. G.N.Galkin.

Fiz. tverdogo Tela, Vol. 2, No. 1, 8-14 (Jan., 1960). In Russian.

The method of Kalashnikov and Penin [Zh. tekh. Fiz., Vol. 23, 1111 (1955)] is used in which the variation of rectifying properties with the frequency of applied a.c. is measured. Conditions for applicability are enumerated. If the series resistance is much larger than the differential resistance of the p—n junction then the lifetime is inversely proportional to the critical frequency at which the rectified current is half its value for low frequencies. The specimen was ~ 4 ohm cm with $\tau > 10$ μsec. It was heated to 1230-1240° C, held for 5-40 min and cooled at about 10°/min. τ was measured for various levels of injection from −78° to +160° C. The results fit the theory for one recombination level in the lower half of the forbidden zone 0.13 ± 0.01 eV above the valence band. The temperature variation of the capture cross-sections for electrons and holes are derived, but absolute values are not known. If the effect is due to diffusion of impurities, then the coefficient of diffusion is about 10^{-5} cm^2/sec. This corresponds to Cu, but Cu does not give rise to level at 0.13 eV.
R.Berman

539.2 : 537.311

7933 INTERNAL IMPURITY LEVELS IN SEMICONDUCTORS: EXPERIMENTS IN P-TYPE SILICON.
S.Zwerdling, K.J.Button, B.Lax and L.M.Roth.

Phys. Rev. Letters, Vol. 4, No. 4, 173-6 (Feb. 15, 1960).

The existence of multiple sets of impurity levels, each associated with a particular band extremum, was demonstrated by the observation, at 4° K, of optical transitions to acceptors above the $p_{\frac{1}{2}}$ valence band, but below the top of the $p_{3/2}$ band. Several transitions were observed, the energies of the excited state following approximately a Rydberg series. The activation energies of various impurities were measured accurately by this method, and the value (0.25 ± 0.01) (0.25 ± 0.01)m_0 was obtained for the hole effective mass. The Zeeman splitting of the internal excited states was also observed.
L.Pincherle

539.2 : 537.311

7934 THE RELATIONSHIP BETWEEN MAGNETISM AND ELECTRICAL CONDUCTIVITY IN COMPOUNDS OF TRANSITION ELEMENTS. F.Hulliger.

Helv. phys. Acta, Vol. 32, No. 6-7, 615-54 (1959). In German.

The nature of the binding forces and the energy states of valence electrons and non-binding 3d or 4f electrons are discussed in relation to the crystal structure of transition metal compounds. Measurements are reported of conductivity of the semiconducting compounds $MnSe_2$, $MnTe_2$, $FeSe_2$, FeP_2, $FeAs_2$, $FeSb_2$, FeAsS, CoSbS, $CoAs_2$, $NiAs_2$ and NiS_2, as well as for the hitherto unknown compounds FePS, FeAsSe, CoPS and CoAsSe.
R.Parker

539.2 : 537.311

7935 THE HALL EFFECT IN FERRITES NEAR THE CURIE TEMPERATURE. K.P.Belov and E.P.Svirina.

Zh. eksper. teor. Fiz., Vol. 37, No. 5(11), 1212-16 (Nov., 1959). In Russian.

The Hall e.m.f. in nickel—zinc and manganese ferrites was measured in the vicinity of the Curie point. A new method of determination of the "usual" Hall constant is suggested. The calculated values of the density and mobilities of the current carriers agree in order of magnitude with the values for nonferromagnetic oxide semiconductors. The Hall e.m.f. is an order of magnitude larger in a manganese ferrite single crystal than in a polycrystalline sample.

539.2 : 537.311

7936 ENERGY SPECTRUM OF HOLES IN Bi_2Te_3.
E.K.Kudinov.

Fiz. tverdogo Tela, Vol. 1, No. 12, 1851-3 (Dec., 1959). In Russian.

A tight-binding calculation is applied to a model which has the layer-structure and symmetry of Bi_2Te_3. The spectrum is determined at the extremum points of the constant energy surfaces and the anisotropy of the effective mass, required to explain the galvanomagnetic effects, is accounted for.
R.B.Stinchcombe

539.2 : 537.311 : 539.219

ELECTRICAL PROPERTIES OF THE Bi_2Te_3—Bi_2S_3 SYSTEM.
See Abstr. 6387

539.2 : 537.311

7937 INVESTIGATION OF SURFACE LAYERS ON CADMIUM TELLURIDE CRYSTALS.
Yu.A.Vodakov, G.A.Lomakina, G.P.Naumov and Yu.P.Maslakovets.

Fiz. tverdogo Tela, Vol. 2, No. 1, 55-61 (Jan., 1960). In Russian.

The conductivity measured at room temperature, after heating at 200° C, was proportional to the square root of the heating time, indicating that the increase in the thickness of the surface layer is due to a diffusion process. The diffusion constant was determined as 4×10^{-10} cm^2/sec. Activation energy for acceptors was 0.2 - 0.5 eV. Thermoelectric power was also measured. Both this and the conductivity return to their initial values after polishing off the surface layer. It is suggested that Cd vacancies are responsible.
R.Berman

539.2 : 537.311

7938 ELECTRICAL PROPERTIES OF CHALCOPYRITE.
B.Donovan and G.Reichenbaum.

Brit. J. appl. Phys., Vol. 9, No. 12, 474-7 (Dec., 1958).

The conductivity σ and thermoelectric power ϕ of synthetic and natural specimens of chalcopyrite have been investigated in the temperature range −140 to 300° C. The Hall coefficient R of the natural specimens has also been measured in this region, but in the case of the synthetic specimens is too small to be detected. For the majority of the specimens the product $R\sigma$ varies approximately as

$T^{0.7}$ from about 100 to −140°C. This is taken to indicate that impurity scattering of the carriers is predominant, and on this basis the effective mass is estimated to be roughly equal to the free electron mass. The low mobility values encountered suggest that the samples are markedly inhomogeneous and this is further borne out by the decrease in the measured resistance at high frequencies.

539.2 : 537.311

7939 CONDUCTIVITY VARIATIONS OF CUPROUS OXIDE LAYERS WITH AN ELECTROSTATIC CHARGE.

A.Deubner and F.Schulz.

Ann. Phys. (Leipzig), Folge 7, Vol. 5, No. 3-4, 113-28 (1960). In German.

Conductivity and field effect were measured as a function of oxygen pressure and temperature. Conductivity measurements were in agreement with previous workers but the field effect results were inconclusive owing to scatter. The influence of adsorbed gases is discussed. Investigations of field effect between −56°C and +30°C in vacuo showed that at room temperature the results are in agreement with those of Zuckler (see Abstr. 3478 of 1954) but hitherto unobserved behaviour is noted at low temperatures. G.C.Williams

539.2 : 537.311

7940 AN EXPERIMENTAL DETERMINATION OF THE POLARON MASS IN CUPROUS OXIDE.

A.I.Gubanov, N.I.Krivko and N.M.Reinov.

Zh. eksper. teor. Fiz., Vol. 38, No. 2, 341-4 (Feb., 1960). In Russian.

The effective mass of the current carriers in Cu_2O at helium temperatures was determined by the diamagnetic resonance method. The value obtained is close to that predicted by Pekar's theory.

539.2 : 537.311

7941 CALCULATION OF TRANSPORT EFFECTS FOR AN ALMOST ENERGY INDEPENDENT RELAXATION TIME. CASE OF INDIUM ANTIMONIDE.

M.Rodot.

C. R. Acad. Sci. (Paris), Vol. 250, No. 3, 1621-3 (Feb. 29, 1960). In French.

Various transport coefficients (including Hall, Seebeck and Nernst coefficients) are evaluated on the assumption of an almost energy independent relaxation time $\tau = \tau_0(1 + A\eta + B\eta^2)$ where η is energy divided by kT and A and B are two parameters. The assumption is consistent with the general properties of these coefficients. P.T.Landsberg

539.2 : 537.311 : 537.534

InSb HALL EFFECT MAGNETOMETER FOR ION BEAM CURRENT MEASUREMENT.

See Abstr. 7166

539.2 : 537.311

7942 ELECTRICAL PROPERTIES OF P-TYPE InP.

M.Glicksman and K.Weiser.

J. Phys. Chem. Solids, Vol. 10, No. 4, 337-40 (Aug., 1959).

Using two samples of p-type InP doped with cadmium, the temperature dependence of the Hall coefficient and mobility were studied yielding (N_A-N_D) values of about 10^{17} cm^{-3} and ionization energies of 0.026 eV and 0.047 eV. Several different values of m* were used to calculate donor concentrations. Two values were also obtained for the lattice mobility, by subtracting calculated impurity mobilities from the measured total values, giving electron to hole mobility ratios of about 30 or 40. I.Cooke

539.2 : 537.311

7943 PIEZORESISTIVE EFFECT IN P TYPE PbTe.

L.E.Hollander and T.J.Diesel.

J. appl. Phys., Vol. 31, No. 4, 692-3 (April, 1960).

A large positive piezoresistive effect has been observed in p-type PbTe. The following room temperature coefficients were determined:

$$\pi_{\text{Hydrostatic}} = +150 \pm 50; \quad \pi_{11} = 80 \pm 30; \quad \pi l_{[111]} = +220 \pm 50,$$

all in 10^{-12}/d. The shear coefficient π_{44} is estimated to be + 255 × × 10^{-12} cm^2/d. The calculated value of π_{12} was + 35 ± 40 × 10^{-12} cm^2/d. These measurements were performed on single-crystal, p type PbTe with a mobility of approximately 700 cm^2/ V sec and a carrier concentration of about 10^{18} per cm^3. Consideration of the coefficients indicates the major axes of the energy ellipsoids are oriented in the [111] direction, which is in agreement with magnetoresistance measurements.

539.2 : 537.311

7944 SOME EFFECTS OF NEUTRON BOMBARDMENT ON MgO CRYSTALS.

W.C.Schieve, M.A.Pomerantz and R.A.Shatas.

Phys. Rev., Vol. 117, No. 6, 1473-5 (March 15, 1960).

Electrical conductivity and post-bombardment conductivity induced in MgO crystals by electron irradiation have been investigated following exposure to neutrons in the Brookhaven pile (integrated epi-cadmium fluxes of 4.2 × 10^{16} n/cm^2 and 5.1 × 10^{17} n/cm respectively). A change in carrier lifetime was observed. No cha in the temperature dependence of the yield was detected, indicating that the mobility of the charge carriers is unaffected by these irra tions. The 1.4-eV shallow trap previously observed was split into levels by the neutron bombardment. This supports the association this level with the 2.2-eV optical transition. Optical absorption me surements were conducted in the 0.6 to 3.0-eV range, and a previou unreported peak has been observed at 74 eV.

539.2 : 537.3

7945 THE ELECTRICAL RESISTIVITY OF OXYGEN DEFICIENT NICKEL FERRITE.

R.Parker and H.Lord.

Proc. Phys. Soc., Vol. 78, Pt 6, 793-5 (Dec., 1959).

An oxygen deficient nickel ferrite has been prepared with a Curie point resistivity of 0.3 ohm cm, which has no resistivity anomaly around the Curie temperature. The material thus does no conform to an empirical rule found by Parker (Abstract 294 of 1959 for other magnetic semiconductors. A prediction of further exceptions to the rule is made. R.Park

539.2 : 537.31

7946 RELATIONS BETWEEN THE CRYSTAL STRUCTURE AND ELECTRONIC PROPERTIES OF THE COMPOUNDS Ag_2S, Ag_2Se, Cu_2Se.

G.Bush and P.Junod.

Helv. phys. Acta, Vol. 32, No. 6-7, 567-600 (1959). In French.

Ag_2S, Ag_2Se, and Cu_2Se were prepared and purified by zone refining. Electrical conductivity, Hall effect, and Seebeck coefficient values, were measured as functions of temperature and structural modification. For the low-temperature β-phase Ag_2S and Ag_2Se ar semiconductors of energy gap 1.3 and 0.07 eV respectively. β-Ag_2 has an electron mobility of nearly 2000 cm^2 $volt^{-1}$ sec^{-1}. The α-phases show metallic properties but with a conduction electron density of only 2-4 × 10^{19} cm^{-3}. Cu_2Se cannot be prepared in stoichiometric form and conduction is always of metallic character. C.A.Hogarth

539.2 : 537.311

7947 A NEW INTERMETALLIC SEMICONDUCTOR.

Ya.A.Ugai and T.N.Vigutova.

Fiz. tverdogo Tela, Vol. 1, No. 12, 1786-8 (Dec., 1959). In Russia

The compound NaSb was found to be a semiconductor. For polycrystalline specimens (prepared from the elements at 650°C in a nitrogen-filled, sealed, metal tube, with subsequent slow coolin the thermal activation energy was 0.82 eV and microhardness 114.5 kg/mm^2. A chemical bonding scheme consistent with semiconductivity is suggested. C.H.L.Goodman

539.2 : 537.31

7948 HALL EFFECT OF THORIUM.

F.Boeschoten and K.J.Groenewolt.

Physica, Vol. 25, No. 5, 398 (May, 1959).

A value of −1.4 × 10^{-12} V cm/GA was found and no dependence on field strength was observed. The resistivity was 19 × 10^{-8} ohm The Hall coefficient is reduced to 50% of the room temperature value on heating to 400°C. D.J.Olive

539.2 : 537.311 :

HALL MOBILITY OF HOLES IN AgBr.

See Abstr. 6955

539.2 : 537.31

7949 PIEZORESISTIVITY IN THE OXIDE SEMICONDUCTOR RUTILE (TiO_2).

L.E.Hollander,Jr., T.J.Diesel and G.L.Vick.

Phys. Rev., Vol. 117, No. 6, 1469-72 (March 15, 1960).

The piezoresistive effect in single crystals was studied. The fourth-rank piezoresistive tensor for the D_{4h} tetragonal symmetry of rutile may be expressed in terms of seven piezoresistive coefficients. Room-temperature values for these coefficients are presented for different resistivity material in the range from approximately 1000 to 0.1 ohm cm, resulting from various concentrations of oxygen deficiency in the nonstoichiometric TiO_2 lattice. Some o these coefficients were also measured at 77° and 380°K. The meas red piezoresistive ceofficients are of the order of + 10^{-11} cm^2/dyn The longitudinal piezoresistive coefficient measured along the "c" axis, π_{33}, diminishes with increasing oxygen deficiency, while that along the "a" axis, π_{11}, increases with oxygen deficiency. This trend is interpreted in terms of the impurity band conduction model proposed for rutile.

539.2 : 537.311 : 621.382.22

7950 THE TEMPERATURE DEPENDENCE OF NOISE TEMPERATURE RATIO IN GERMANIUM DIODES.

A.Hendry.

Brit. J. appl. Phys., Vol. 9, No. 11, 458-60 (Nov., 1958).

Measurements of the 30 Mc/s noise temperature ratio of a d.c. biased germanium mixer diode at various mixer temperatures are reported. The noise temperature ratio is observed to increase as the temperature is lowered, indicating the presence of noise which is substantially in excess of thermal and shot noise, and which increases in magnitude as the temperature is lowered.

539.2 : 537.311 : 621.382.232

7951 GALLIUM ARSENIDE TUNNEL DIODES.

K.G.Hambleton, J.J.Low and R.J.Sherwell.

Nature (London), Vol. 185, 676-7 (March 5, 1960).

Zn-doped GaAs prepared by diffusion to an impurity concentration of 9×10^{19} cm^{-3} had Sn alloyed on to form a junction. Negative resistances ranging from 0.1 to 4 ohm were obtained, with peak currents of 70 mA to 7A occurring at 0.13 to 0.50 V for different devices, and valley currents about 1/15 of the peak occurring at 0.35 to 0.55 V. Relaxation oscillations at 300-560 Mc/s were observed, with harmonics up to at least 1 kMc/s. F.F.Roberts

539.2 : 537.311 : 621.382.23

7952 SEMICONDUCTOR VARACTORS USING SURFACE SPACE-CHARGE LAYERS.

W.G.Pfann and C.G.B.Garrett.

Proc. Inst. Radio Engrs., Vol. 47, No. 11, 2011-12 (Nov., 1959).

Outlines the expected properties of a variable-capacitance diode having the structure metal—oxide—silicon—metal. Accumulation, depletion and inversion layers can appear in the silicon, adjacent to the oxide, under suitable bias conditions, and carrier lifetime effects can become significant under certain circumstances. Other structures are briefly mentioned. F.F.Roberts

539.2 : 537.311

7953 THE SYNTHESIS OF SEMICONDUCTING MATERIALS USING VIBRATIONAL MIXING.

A.S.Borshchevskii and D.N.Tret'yakov.

Fiz. tverdogo Tela, Vol. 1, No. 9, 1483-5 (Sept., 1959). In Russian.

InAs, GaAs, AlAs, InP, GaP, CdSe, ZnSe, Ga_2S_3 and mixtures of these were prepared by heating the elements in a quartz ampoule within a quartz tube inserted in a furnace. The quartz tube was connected to the membrane of a 40 W, 100 c/s electromagnetic vibrator. The use of the vibrator brought about a 4 to 25-fold improvement of performance by cutting down the heating time and permitting larger batches to be handled. With the assitance of the vibrator it was also possible to prepare at feasible furnace temperatures materials ordinarily requiring notably higher temperatures for their production. C.R.S.Manders

Photoconductivity

539.2 : 537.312

7954 INFLUENCE OF TRANSVERSE MODES ON PHOTOCONDUCTIVE DECAY IN FILAMENTS.

J.S.Blakemore and K.C.Nomura.

J. appl. Phys., Vol. 31, No. 5, 753-61 (May, 1960).

The roles of high order modes are discussed for the decay of excess carriers in a semiconducting filament. A general solution is given for the strength of the various modes when excess generation (i.e., illumination) is any function of time and space. Solutions for several specific cases are illustrated in graphical and tabular form. It is well known from the discussions of Shockley and of Stevenson and Keyes that odd numbered modes can augment the surface recombination of the fundamental mode: the present calculations show that for typical generative procedures this increased recombination is considerably more serious than has been generally supposed. The role is noted of even numbered (antisymmetric) modes, which contribute nothing to filament photoconductance, but which arise under antisymmetric generation conditions to describe transverse diffusion (and usually to disturb the relative amplitudes of the odd modes). Attention is drawn to the fact that some odd modes can have a generative behaviour when carrier creation is a suitable function of position. This is turned to advantage in suggesting how lifetime may be measured in a filament with minimum interference from the surface.

539.2 : 537.312

7955 THE FINE STRUCTURE OF THE PHOTOCONDUCTIVITY SPECTRA OF CADMIUM SULPHIDE CRYSTALS.

E.F.Gross and B.V.Novikov.

Fiz. tverdogo Tela, Vol. 1, No. 3, 357-62 (March, 1959). In Russian.

The wavelengths of photoconductivity maxima of some CdS monocrystals at 77.3°K coincided with their optical absorption maxima (type I crystals) while other CdS monocrystals (at the same temperature) had photoconductivity minima at the wavelengths of the absorption maxima (type II crystals). Heating to 400-500°C and rapid cooling (quenching) converted the type I crystals into crystals of type II, but left unaffected those which were originally of type II. After annealing (heating to 400-500°C and 10-12 hour cooling) the type II crystals acquired type I properties, but the properties of the type I crystals were unaffected. The strong absorption lines and the corresponding photoconductivity maxima are both ascribed to excitons. The photoconductivity minima are said to be due to intense exciton annihilation at the surfaces of strongly defective monocrystals; this is confirmed by disappearance of the photoconductivity minima after healing up defects by annealing. A.Tybulewicz

539.2 : 537.312 : 537.53

7956 VARIATION OF THE CADMIUM SULFIDE CONTACT POTENTIAL DURING ILLUMINATION.

G.K.Zyryanov.

Zh. tekh. Fiz., Vol. 28, No. 12, 2657-68 (Dec., 1958). In Russian. English translation in: Soviet Physics—Technical Physics (New York), Vol. 3, No. 12, 2429-38 (Dec., 1958).

The photoshift method (displacement of the V—I curves) was used with simultaneous measurement of the electron current due to scattering and reflection from the CdS surface layer. It was found that reflection of slow electrons with energies from 1 to 10 eV at the semiconducting layer did not increase monotonically, but displayed minima and maxima at given electron velocities. The minima are presumably due to inelastic collisions between the electrons and their subsequent transition from the filled band to the conduction band (in this way it is possible to measure the width of the forbidden zone). The time and spectral relationships of the photoshift are similar to the corresponding photoconductivity curves. The dependence of the photoelectric shift on the intensity of illumination is logarithmic. It is demonstrated that the experimental data can be described by the known photo-e.m.f. formula without the necessity for an adsorbed gas film at the CdS surface, as postulated by Wlerick (Abstr. 8208 of 1956). Evaluation of the coefficients in the experimental formula gives a "quantum yield" in excess of 10^3. The possibility of explaining the results on the basis of diffusion theory is investigated.

539.2 : 537.312

7957 PREPARATION OF MIXED CdS.CdSe MONOCRYSTALS FROM VAPOUR PHASE AND SOME OF THEIR PROPERTIES.

N.I.Vitrikhovskii and I.B.Mizetskaya.

Fiz. tverdogo Tela, Vol. 1, No. 3, 397-402 (March, 1959). In Russian.

CdS and finely powdered selenium were throughly mixed and heated for 5-6 hours at 400-450°C; selenium and sulphur not used up in the reaction were volatilized during this treatment. The product was ground and then sublimated in an atmosphere of argon at 980-1100°C. CdS.CdSe monocrystals prepared in this way were found to be substitutional solid solutions. Studies of photoconductivity showed that a stable position of the photocurrent maximum in a batch of CdS.CdSe monocrystals of given composition was a proof of uniform composition within that batch. The wavelengths at which the photocurrent maxima occurred depended linearly on the composition of the monocrystals. A.Tybulewicz

539.2 : 537.312

7958 ON THE LIFE-TIME OF MINORITY CARRIERS IN THE SUB-SURFACE LAYER IN CdSe + Ag SINGLE CRYSTALS.

U.B.Soltamov and I.G.Perestoronin.

Fiz. tverdogo Tela, Vol. 2, No. 1, 26-7 (Jan., 1960). In Russian.

Low energy electrons were used for activation. Curves show lifetime and cathodoconductivity current as functions of initial electron energy for constant beam power. It is deduced that lifetime increases with decreasing depth of formation of carriers. R.Berman

539.2 : 537.312

7959 PHOTOVOLTAIC EFFECTS IN CdS CRYSTALS.
H.Kallmann, B.Kramer, J.Shain and G.M.Spruch.

Phys. Rev., Vol. 117, No. 6, 1482-6 (March 15, 1960).

Photovoltages were obtained in CdS crystals using inhomogeneous excitation; that is, the excitation at one electrode was much larger than at the other electrode. Voltages in the range of 200 millivolts were obtained, with the region of high excitation always becoming positive. Two types of electrode arrangements were used. Some crystals were contacted directly with electrodes, others were insulated from the electrodes by thin Mylar sheets. In the first arrangement the photovoltages were permanent, in the second transient. The photovoltage showed only a weak dependence on intensity, and only wavelengths near or shorter than that corresponding to the absorption edge were effective. With metal electrodes the photovoltages were small. However, with jelly electrodes contacting the crystals photovoltages were almost as large as for the insulated crystals.

539.2 : 537.312

7960 IMPURITY PHOTOCONDUCTIVITY IN GERMANIUM.
H.Levinstein.

Proc. Inst. Radio Engrs, Vol. 47, No. 9, 1478-81 (Sept., 1959).

Photocells made of gold- or zinc-doped germanium are described, and their spectral response, sensitivity and time constant given. C.Hilsum

539.2 : 537.312

7961 PHOTOCONDUCTIVITY IN INDIUM SULFIDE POWDERS AND CRYSTALS.
R.H.Bube and W.H.McCarroll.

J. Phys. Chem. Solids, Vol. 10, No. 4, 333-5 (Aug., 1959).

Photo effects in In_2S_3 and $CdIn_2S_4$ are investigated. Measurements include spectral response and temperature dependence of photo current. C.D.Cox

539.2 : 537.312

7962 FILM-TYPE INFRARED PHOTOCONDUCTORS.
R.J.Cashman.

Proc. Inst. Radio Engrs, Vol. 47, No. 9, 1471-5 (Sept., 1959).

A description of the preparation and properties of Tl_2S, PbS, PbSe and PbTe polycrystalline photocells. Details are given of spectral response, sensitivity, time constant and noise spectrum. C.Hilsum

539.2 : 537.312

7963 NOISE AND SIGNAL RESPONSE IN LEAD SULFIDE PHOTOCONDUCTIVE FILMS.
H.E.Spencer.

J. appl. Phys., Vol. 31, No. 3, 505-10 (March, 1960).

Experimental noise and signal response data of two lead sulphide photoconductive films have been obtained as a function of frequency and radiation wavelength at temperatures ranging from about 25° C to −173° C. Good agreement between experiment and a theory proposed by Petritz is found (Abstr. 2247 of 1957). The theory is used in such a way that correlations between noise and response may be made independently of the temperature. The measured time constants enter into the correlations only indirectly; they are necessary only to extrapolate data measured at a given frequency to some lower frequency. Generation-recombination noise predominates at all temperatures. Time constants measured by noise and by response agree. The role of absorbed ambient photons is described. These photons are important at the lower temperatures. The concentrations of the majority carriers (holes) and their mobility as derived from signal data are listed.

539.2 : 537.312

7964 CURRENT FLUCTUATIONS IN PbS CELLS.
F.M.Klaassen and J.Blok.

Physica, Vol. 24, No. 12, 975-84 (Dec., 1958).

Measurements are reported of the noise spectrum and the photoresponse of PbS cells (Kodak Ektron detectors) in the range 1 c/s-20 kc/s. Analysis of this spectrum suggests that it is partly due to contact noise, partly to generation–recombination noise. The dependence of the spectrum on the intensity of an additional irradiation and on the temperature was measured. Photoresponse curves were also measured; these curves were in agreement with the noise spectra. Comparing the results with theories based on models for the photoconductivity mechanism it was found that a good description of the experimental results were given with the majority carrier model (Petritz, Abstr. 2247, 4370 of 1957). Some results however contradict the barrier model (Slater, Abstr. 399 of 1957).

539.2 : 537.312 : 536

7965 EFFECT OF TEMPERATURE ON THE RESPONSE OF A LEAD SULPHIDE CELL.
M.Lunel.

J. Phys. Radium, Vol. 18, No. 3, 61 A-62 A (March, 1957). In Fren

Reports that the infrared reponse is approximately inversely proportional to the temperature of the photocell over the range 19-35° C. The results show that lowering the temperature by 15° C causes a 53% increase in output, and that such a cell - when used fc stellar infrared measurements - should be thermostatted at a low temperature. D.L.Greenaw

539.2 : 537.31

7966 THE EFFECT OF THE ADDITION OF Tl AND TlCl ON THE CONDUCTIVITY AND PHOTOCONDUCTIVITY OF SELENIUM.
I.P.Shapiro.

Fiz. tverdogo Tela, Vol. 1, No. 12, 1782-5 (Dec., 1959). In Russian

The change in conductivity and photoconductivity of selenium h been examined for various concentrations of thallium and thallium chloride. Several curves of the spectral sensitivity of the photocurrent are shown. K.N.R.Taylo

539.2 : 537.31

7967 EFFECT OF TEMPERATURE ON PHOTOVOLTAIC SOLAR ENERGY CONVERSION.
J.J.Wysocki and P.Rappaport.

J. appl. Phys., Vol. 31, No. 3, 571-8 (March, 1960).

Photovoltaic solar energy conversion is investigated theoretically over a temperature range of 0-400° C using semiconductor materials with band gaps varying from 0.7 to 2.4 eV. Three cases are considered. In Case I, the junction current is the ideal current In Case II, the junction current is the ideal plus a recombination current; and in Case III, a recombination current. The best conversion performance is obtained for the ideal current; the worst, for the recombination current. The maximum conversion efficienc occurs in materials with higher band gap as the temperature is increased. GaAs is close to the optimum material for temperature below 200° C. Experimental measurements are presented on Si, GaAs, and CdS cells. The measurements on Si and GaAs agree wit theoretical expectations as far as the gross behaviour is concerned The CdS cell behaves anomalously as if it were made from a mater with band gap of 1.1 eV.

Thermoelectric Properties

539.2 : 537.32

7968 INVESTIGATIONS ON SILVER–SELENIUM LAYERS.
G.Kienel.

Ann. Phys. (Leipzig), Folge 7, Vol. 5, No. 3-4, 229-36 (1960). In Germa

The variation of resistivity and thermoelectric power of selenium layers, as a function of the % of Ag added, were measured using Au electrodes. Four maxima in the values were observed corresponding to the compounds $AgSe_2$, AgSe, Ag_3Se_2 and Ag_2Se. Th thermopile couple consisting of Au and 72% Ag + 28% Se (approximating to the compound Ag_2Se) had the greatest output, because of its low resistance. G.C.William

539.2 : 537.3

7969 NERNST AND ETTINGSHAUSEN EFFECTS IN SILICON BETWEEN 300° K AND 800° K.
H.Mette, W.W.Gärtner and C.Loscoe.

Phys. Rev., Vol. 117, No. 6, 1491-3 (March 15, 1960).

The Nernst and Ettingshausen coefficients in p-type silicon sing crystals of various impurity densities were measured over a tempe ture range between 300° K and 800° K at magnetic fields of 9000 gaus The results are in good agreement with the theoretical predictions. Using the measured coefficients in the Bridgman relation, values were obtained for the thermal conductivity of silicon in the tempera ture range between 550° K and 800° K.

539.2 : 537.3

7970 THE ANISOTROPIC THERMOELECTRIC POWER OF GRAPHITE.
L.C.F.Blackman, P.H.Dundas and A.R.Ubbelohde.

Proc. Roy. Soc. A, Vol. 255, 293-306 (April 16, 1960).

In order to characterize the anisotropy, measurements of therr electric power at ordinary temperatures were made as a function of direction on various specimens of graphite. These included commercial polycrystalline graphite partly oriented during its manufactu compacts of small near-ideal crystal flakes oriented by compression, well-oriented pyrolytic graphite, and natural graphite with good columnar orientation parallel to the a-axis. Measurements were also made on the thermoelectric force between well-oriented pyrolytic and polycrystalline graphite, over the temperature range 2800° to [illegible]0° K. Effects on the thermoelectric power of deliberately introducing crystal defects were examined for crystal compounds in which the graphite acts as electron donor or electron acceptor. Results are discussed in relation to some current theories of thermoelectric power in solids.

539.2 : 537.32 : 621.791.76

7971 INVESTIGATIONS OF THE INFLUENCE OF THE PELTIER EFFECT ON RESISTANCE WELDS.

S.Scholz.

Z. angew Phys., Vol. 12, No. 3, 111-17 (March, 1960). In German.

The Peltier effect gives rise to resistance welds of varying strengths, in combinations of metals of different thermoelectric properties, depending on the direction of the current pulse during welding. Calculations for Au–Pd show that the Peltier heat is about 10% of the electrical energy dissipated in the weld; a result confirmed experimentally. G.C.Williams

539.2 : 537.32 : 537.3

INFORMATION ON DEFECTS IN IONIC CRYSTALS FROM THE SEEBECK EFFECT — A SUMMARY. See Abstr. 7878

539.2 : 537.32 : 669

7972 THE SINTERING OF BISMUTH TELLURIDE.

W.R.George, R.Sharples and J.E.Thompson.

Proc. Phys. Soc., Vol. 74, Pt 6, 768-70 (Dec., 1959).

A tentative explanation of the variation of thermoelectric power of compacted specimens of Bi_2Te_3 with sintering temperature is proposed. The changes in conduction type observed are consistent with the removal of strains and decrease in dislocation density, introduced in crushing and compacting of the powder at room temperature, as the sintering temperature is raised. The results cannot be attributed to the loss of one or other of the components or to contamination. G.C.Williams

Dielectric Properties

539.2 : 537.2

7973 THE DIELECTRIC CONSTANT OF ZINC OXIDE OVER A RANGE OF FREQUENCIES.

N.H.Langton and D.Matthews.

Brit. J. appl. Phys., Vol. 9, No. 11, 453-6 (Nov., 1958).

The dielectric constant of a colloidal zinc oxide has been measured by the method of mixtures, using cyclohexanol and ethyl acetate as the suspending liquids. The dielectric constant has been found to be 10.4 over the frequency range 105 kc/s to 1 0 Mc/s, falling to 9.4 at 25 Mc/s, measurements being made at 25° C with an accuracy of 2.3%. The dielectric constant of an acicular zinc oxide has been found to have an apparent value of about 40, over the frequency range 100 kc/s to 10 Mc/s. Results are given of dielectric constant measurements on mixtures of cyclohexanol and ethyl acetate, which appear to disobey Lichteneker's empirical logarithmic mixing rule. (Abstr. 1653 of 1926).

539.2 : 537.2

7974 DIELECTRIC POLARIZATION OF A SERIES OF COMPOUNDS OF COMPLEX STRUCTURE.

G.A.Smolenskii and A.I.Agranovskaya.

Fiz. tverdogo Tela, Vol. 1, No. 10, 1562-72 (Oct., 1959). In Russian.

A series of complex oxides and their solid solutions were predicted theoretically by considering the condition of electric neutrality, properties of crystal structure, and the tendency of ions towards a definite coordination number. These compounds were later synthesized and their properties investigated. It was found that $Pb_3NiNb_2O_9$ and $Pb_3MgNb_2O_9$ had the highest permittivity (order of 10^3), the latter material being ferroelectric. An explanation of the dielectric relaxation phenomena in $Pb_3NiNb_2O_9$ is included; a tentative suggestion being made that the activation energy is a minimum in the phase-transition region. E.M.Dembinski

539.2 : 537.2 : 532.7

DIELECTRIC PROPERTIES OF γ-RAY IRRADIATED METHYL-METHACRYLATE AND POLYMETHYL-METHACRYLATE. See Abstr. 6803

539.2 : 537.2

7975 THE MECHANISM OF THE REVERSAL OF THE SPONTANEOUS POLARIZATION IN $LiH_3(SeO_3)_2$ SINGLE CRYSTALS.

E.Fatuzzo.

Helv. phys. Acta, Vol. 33, No. 1, 21-6 (1960).

The reversal of the spontaneous polarization in $LiH_3(SeO_3)_2$ crystals was studied as a function of applied electric field. Except for very low fields, the switching time t_s follows a power law of the form: $t_s = kE^{-5/2}$. Thermal and electrical treatment of the sample showed that up to fields of 50 kV/cm the switching time is controlled primarily by the nucleation of new domains. It thus appears that the 5/2 power law is determined by the nucleation rather than by the domain wall motion. The interaction between domains and nuclei in $LiH_3(SeO_3)_2$ was found to be very high. It is proposed that all ferroelectrics with a high spontaneous polarization like $BaTiO_3$ and $LiH_3(SeO_3)_2$ tend to show a strong domain-nucleus interaction.

539.2 : 537.2

7976 ON THE DIELECTRIC CONSTANT OF GERMANIUM AT MICROWAVE FREQUENCIES.

A.C.Baynham, A.F.Gibson and J.W.Granville.

Proc. Phys. Soc., Vol. 75, Pt 2, 306-9 (Feb., 1960).

Measurements of the variation of phase shift with sample thickness were used to obtain the wavelength in the sample, and hence the dielectric constant, at frequencies within the range 30 to 37 kMc/s. These results fit a theoretical dispersion curve with a resonant frequency of 32.20 kMc/s. The additional absorption associated with the dispersion is small (3 dB/cm). R.C.Kell

539.2 : 537.2

7977 NONDESTRUCTIVE MEASURING METHOD OF POLARIZATION FOR THE STUDY OF FERROELECTRICS.

K.Husimi and K.Kataoka.

Rev. sci. Instrum., Vol. 31, No. 4, 418-21 (April, 1960).

The piezoelectric output voltage of a ferroelectric crystal in an ultrasonic field is determined by its state of polarization. By using this property, a technique has been developed for the measurement of polarization without disturbing the domain configuration. This ultrasonic method has several advantages over the Sawyer–Tower method and Chynoweth's pyroelectric method (Abstr. 6603 of 1956). Quasi-static hysteresis measurements of a barium titanate single crystal have been carried out to illustrate the method.

539.2 : 537.2

7978 ANTIFERROELECTRIC AND FERROELECTRIC PROPERTIES OF SEVERAL SOLID SOLUTIONS CONTAINING Pb_2MgWO_6.

N.N.Krainik and A.I.Agranovskaya.

Fiz. tverdogo Tela, Vol. 2, No. 1, 70-2 (Jan., 1960). In Russian.

Previously (G.A.Smolenskii et al., Abstr, 638 of 1960), it was shown that Pb_2MgWO_6 exhibits anomalous dielectric properties, having a maximum permittivity at 40° C; it is antiferromagnetic below 40° C. The present paper is concerned with $PbMg_{1/2}W_{1/2}O_3$, a pure antiferromagnetic in combination with $PbTiO_3$ or $PbMg_{1/3}Nb_{2/3}O_3$. The dielectric maxima of a series of samples of of different composition have been measured in the temperature range −200 to +300° C. The Curie temperature of these compounds at first drops with increasing $PbTiO_3$ content, passes through a minimum and then rises at higher contents. The significance of the results is briefly discussed. A.E.I.Research Laboratory

539.2 : 537.2

7979 SOLID SOLUTIONS OF NIOBATES AND TANTALATES OF TRANSITION METALS BASED ON $BaTiO_3$.

E.V.Sinyakov and E.A.Stafiichuk.

Fiz. tverdogo Tela, Vol. 2, No. 1, 73-9 (Jan., 1960). In Russian.

Pyro - and metaniobates and tantalates of Mn, Co and Ni were prepared by standard methods. These compounds are not ferroelectric within temperature range −195° C to +195° C. $BaTiO_3$ becomes non-ferroelectric when more than 1 mole% of metaniobate or tantalate is dissolved in it. Pyroniobates and tantalates of Mn, Co and Ni solid solutions in $BaTiO_3$ are ferroelectric. J.Adam

539.2 : 537.2

7980 FERROELECTRIC TRANSITION IN RUBIDIUM BISULFATE.

R.Pepinsky and K.Vedam.

Phys. Rev., Vol. 117, No. 6, 1502-3 (March 15, 1960).

$RbHSO_4$ is ferroelectric below −15° C. The room-temperature phase is monoclinic, with space group $P2_1/c$, $a = 14.35_6$ A, $b = 4.62_2$ A, $c = 14.80_7$ A, $\beta = 121.0^\circ$ and $Z = 8$. The symmetry of the ferroelectric phase is Pc, as established by systematic X-ray absences and the fact that spontaneous polarization appears along the c axis below -15°C. Both the high- and low-temperature phases are pseudo-orthorhombic. The dielectric constant ϵ_c at 10 kc/s and for a field of 5 v/cm is 10 at room temperature; as the temperature is lowered, ϵ_c rises to a sharp peak of ~240 at -15°C and falls to ~5 at -196°C. The transition appears to be of second order. No second transition, as in the case of isomorphous NH_4HSO_4, could be detected in the temperature range -15°C to -196°C.

539.2 : 537.2

7981 ON THE FERROELECTRIC BEHAVIOUR OF POTASSIUM DIHYDROGEN PHOSPHATE.

J.Grindlay and D.ter Haar.

Proc. Roy. Soc. A, Vol. 1261, 266-85 (March 10, 1959).

The behaviour of potassium dihydrogen phosphate (KDP) is compared with that of some isomorphous crystals. From this comparison it is concluded that the hydrogen bonds play a deciding part in the phase transition, although the magnitude of the polarization seems to be determined by the heavy ions. As a first theoretical approach the first Bethe approximation is applied to an Ising model, based on the hydrogen lattice of KDP. This model contains an additional configurational energy U as compared to Slater's work. His results are obtained in the limit as $U \to \infty$. A phase transition is found for all positive values of U, but according to whether U is larger than or smaller than a certain value, which is about $\frac{3}{2}$ times Slater's energy parameter, the transition is a first- or a second-order one. An ionic model of KDP is considered which is treated as a polar hydrogen lattice with interprenetrating ionic potassium, phosphorus, and oxygen lattices. As far as possible the detailed behaviour of the constituent atoms is taken into account. The rigidity of the hydrogen bond, the effect of the configurational energy of the hydrogen ions about phosphate tethrahedra, and the displacements of the K, P and O ions from their lattice sites all appear explicitly in the calculations. It is not found possible to choose the parameters in such a way that the complete temperature dependence of the susceptibility can be fitted. The combination of a hydrogen triggering mechanism and the neutron diffraction data imply effective changes of opposite sign for the K and P ions, in disagreement with the expected properties of electro-positive atoms. On the other hand, however, this model gives not only a qualitative account of the similarity of the ferroelectric properties of KDP and its isomorphs, but also of the difference in the temperature independent part of the susceptibility in the ferroelectric and paraelectric phases of KDP, respectively.

539.2 : 537.2

7982 THE EFFECT OF THE ADDITION OF Fe_2O_3, V_2O_5 AND SnO_2 ON THE DIELECTRIC PROPERTIES OF CERAMIC BARIUM TITANATE.

G.Lapluye, G.Morinet and P.Palla.

C.R. Acad. Sci. (Paris), Vol. 250, No. 1, 79-81 (Jan. 4, 1960).
In French.

The addition of up to 10 mole % of Fe_2O_3, V_2O_5 or SnO_2 to a ceramic barium titanate of composition ratio BaO to TiO_2 of 1.05 : 1 is shown to markedly lower the Curie temperature, and raise the power factor at 20°C. Smaller changes occur in the permittivity at 20°C and at the Curie point. L.E.Cross

539.2 : 537.2

7983 MOTION OF 180° DOMAIN-WALLS IN METAL ELECTRODED BARIUM TITANATE CRYSTALS AS A FUNCTION OF ELECTRIC FIELD AND SAMPLE THICKNESS.

R.C.Miller and A.Savage.

J. appl. Phys., Vol. 31, No. 4, 662-9 (April, 1960).

The domain dynamics of polarization reversal in metal electroded $BaTiO_3$ single crystals have not been adequately described in the literature. Quantitative measurements of the velocity of the sidewise motion of 180° domain-walls in $BaTiO_3$ crystals are given most of which were electroded with 200 A thick films of Au. The wall velocity has been measured as a function of several variables including the applied electric field, the crystal thickness and the impurity content added to the crystal growth melts. The wall velocity as a function of the field E is described by $v_\infty \exp(-\delta/E)$ where δ and v_∞ are constants over several decades of velocity. The quantities δ and v_∞ are the activation field and extrapolated wall velocity for $E = \infty$, respectively. This field dependence of the wall velocity is the same as that reported previously for liquid electroded specimens. The thickness dependence of the wall velocity which is through δ, is very pronounced and similar to that observed in measurements of other variables under different experimental conditions. The present data are explained in terms of a surface layer estimated to be of the order of 100 A thick. It is suggested that high fields within the surface layer may give rise to electron field emission and the electroluminescence which is observed during polarization reversal. Effects on the wall motion which persist for times of the order of minutes are ascribed to dielectric relaxation phenomena. The observed dependence of the wall motion on the impurity content of the crystal, and several other parameter may result from changes in the characteristics of the surface laye

539.2 : 537.

7984 MECHANISM FOR THE SIDEWISE MOTION OF 180° DOMAIN WALLS IN BARIUM TITANATE.

R.C.Miller and G.Weinrich.

Phys. Rev., Vol. 117, No. 6, 1460-6 (March 15, 1960).

An important unanswered question concerning the sidewise mot of 180° domain walls in single crystal $BaTiO_3$ is the mechanism by which the boundaries move. This paper considers two possible models. One model assumes that the wall motion results from the repeated nucleation of steps along existing parent 180° domain wall and that the nucleation rate is the controlling factor in the propaga tion of the wall. The second model investigated involves paired screw dislocations of opposite sense which propagate the wall in a manner analogous to certain types of crystal growth. Many feature of the experimental data are consistent with the nucleation model. The nucleated steps are assumed to be triangular slabs, along the wall and about one lattice constant thick. For a field of 300 Vcm^{-1}, the critical nucleus is calculated to be 7×10^{-6} cm wide (along the electroded crystal surface) and 16×10^{-6} cm high (along the ferroelectric axis). For limited ranges of field, the model gives a wall velocity dependence on field of $\nu \propto \exp(-\delta/E)$, which agrees with ex periment. The magnitude of the calculated activation field δ agree with experiment if the energy of the additional wall consequent on a nucleation is set equal to 0.4 ergs cm^{-2}. The calculated temperatu dependence of δ is through $P_S^3 T^{-1} \epsilon_a^{-1/2}$ and is in fair quantitative agreement with experiment. The approximately square domains observed in the low field region are consistent with the model, and the change in shape of the domains observed at higher fields can likewise be explained if slightly different wall energies are assume for the edges of the nucleated steps on the two different types of 18 domain walls. The screw dislocation model does not predict a wall velocity $\nu \propto \exp(-\delta/E)$ in a straightforward way. It is only with certain unrealistic restrictions on the dislocation density or the wall mobility that this model will give the correct form of ν. However, it is suggested that this mechanism may contribute to the wall motio with fields of a few thousand volts per centimetre or higher.

539.2 : 537.2 : 548.

THE RELATION BETWEEN STRUCTURE AND FERROELECTRICITY IN LEAD BARIUM AND BARIUM STRONTIUM NIOBATES.
See Abstr. 8217

539.2 : 537.2 : 548.7

X-RAY, DIELECTRIC, AND OPTICAL STUDY OF FERROELEC TRIC LEAD METATANTALATE AND RELATED COMPOUNDS.
See Abstr. 8218

539.2 : 537.2

7985 ON THE DIELECTRIC LOSS OF OXIDISED HIGH-DENSITY POLYETHYLENE.

S.Okamoto and K.Takeuch

J. Phys. Soc. Japan, Vol. 14, No. 3, 378 (March, 1959).

High density polyethylene was photo-oxidized by exposure to u.v. for 60 hr. Dielectric loss for 30 to 10^6 c/s and -75 to 100°C was measured. Three loss peaks, α, β, γ are observed of which α is prominent in contrast with earlier reports. J.G.Powle

539.2 : 537.2 : 621.315.61

7986 TEMPERATURE DEPENDENCE OF DIELECTRIC LOSS OF SHELLAC IN MICROWAVE REGION.

S.S.Srivastava, D.D.Puri and P.C.Mehendru.

Proc. Nat. Inst. Sci. India A, Vol. 23, No. 4, 289-92 (1957).

Microwave dielectric loss of commercial grades of shellac has been measured in the 3 cm region over a temperature range of 20 to 50°C. A waveguide cell was designed for keeping the temperatur constant over the range for the duration of measurements. A standi wave technique was used for measuring the dielectric constant and loss factor. The tan δ of shellac is found to increase rapidly with temperature below their softening point in all the three high-purity grades examined.

539.2 : 537.

7987 FURTHER CONTRIBUTION TO THE TEMPERATURE DEPENDENCE OF THE ELECTRIC STRENGTH OF IONIC CRYSTALLINE DIELECTRICS.

V.D.Kuchin.

Fiz. tverdogo Tela, Vol. 1, No. 3, 450-5 (March, 1959). In Russian.

The electric strength of KCl, KBr, and KI grown from melt and of natural rocksalt was measured between −30 and 150°C; both constant voltages and pulses of $10^{-4} - 10^{-8}$ sec duration were used. The temperature dependences of the electric strength of all these crystals had maxima between 0 and 100°C, when constant voltages or pulses $10^{-4} - 10^{-8}$ sec rise-times were used. These maxima are discussed in terms of different temperature dependences below and above 0°C of the electron energy gain (from the applied field) and loss (to the lattice). When pulses of 2-5 x 10^{-8} sec rise-times were used the electric strengths of all the crystals were (i) twice as high as those obtained with 10^{-6} sec pulses, and (ii) independent of temperature between −150 and 150°C. Here breakdown was assumed to be purely mechanical, since discharges were unable to follow changes of the applied field. A.Tybulewicz

539.2 : 537.2

7988

SYNTHETIC PIEZOELECTRIC MATERIALS.

R.Svoboda, J.Tichý and J.Zelenka.

Slaboproudy Obzor, Vol. 21, No. 2, 66-72 (1960). In Czech.

This review deals with the following materials: ethylene diamine tartrate (EDT), dipotassium tartrate (DKT), lithium sulphate hydrate (LSH), sorbitol hexa-acetate (SHA), ammonium dihydrogen phosphate (ADP) and potassium dihydrogen phosphate (KDP). The crystallographic properties of the materials in monocrystalline form are briefly indicated and their matrices are given. The elastic, piezoelectric, dielectric and thermal constants of the materials are indicated in five tables, and their electrical applications are briefly discussed. R.S.Sidorowicz

OPTICAL PROPERTIES OF SOLIDS

539.2 : 535

7989

PHENOMENOLOGICAL DESCRIPTION OF LONG WAVELENGTH OPTICAL VIBRATIONS IN DIATOMIC POLAR CRYSTALS OF THE TRIGONAL, TETRAGONAL AND HEXAGONAL SYSTEMS (ON AN ELECTROSTATIC BASIS).

L.Merten.

Z. Naturforsch., Vol. 15a, No. 1, 47-58 (Jan., 1960). In German.

It is shown that the optical vibrations in the crystal types mentioned can, in the long wavelength limit, be treated phenomenologically as in the case of cubic crystals. The crystal data required for this purpose are the dispersion frequencies and dielectric constant. Frequencies and directions of polarization are determined for the three branches. It is seen that one branch is in general purely transverse; the other two are respectively purely transverse and purely longitudinal only for certain special directions. In contrast to those of the first branch the frequencies of the other two depend upon the direction of propagation. The conditions for the validity of the theory are formulated and wurzite is cited as an example of a lattice for which these are fulfilled. J.W.Leech

539.2 : 535

7990

OPTICAL CONSTANTS OF GERMANIUM IN THE REGION 0 - 10 eV.

M.P.Rimmer and D.L.Dexter.

J. appl. Phys., Vol. 31, No. 5, 775-7 (May, 1960).

A programme has been written for the IBM 650 digital computer to evaluate the Kramers—Kronig dispersion relation between real and imaginary parts of the index of refraction, n and k. By this means measurement of the reflection coefficient over a sizable energy range allows the determination of n and k throughout most of this region. Reflection data of Philipp and Taft (see Abstr. 5584 of 1959) on germanium have been analysed in this way, and the results are compared with those of Philipp and Taft obtained by another method. The results are similar, minor differences occurring in the fine structure. The computer programme is available on request.

539.2 : 535 : 548.7

7991

OPTICAL PROPERTIES AND UNIT CELL PARAMETERS OF NICKEL NITRATE HEXAHYDRATE.

A.Jayaraman.

Proc. Indian Acad. Sci. A, Vol. 45, No. 4, 263-7 (April, 1957).

539.2 : 535 : 537.311

OPTICAL AND ELECTRICAL PROPERTIES OF BISMUTH TELLURIDE Bi_2Te_3. See Abstr. 4353

539.2 : 535 : 537.2

OPTICAL AND DIELECTRIC STUDY OF BORACITE. See Abstr. 4377

539.2 : 535 : 537.3

ANOMALOUS SKIN-EFFECT AND THE OPTICAL CONSTANTS OF COPPER, SILVER, GOLD AND NICKEL IN THE INFRARED REGION. See Abstr. 6078

539.2 : 535

7992

THIN-LAYER OPTICS. III. THE PROPERTIES OF SELENIUM.

M.P.Lisitsa, V.M.Maevskii and N.G.Tsvelykh.

Optika i Spetrosk., Vol. 5, No. 2, 179-83 (1958). In Russian. English summary: PB141047T-5, obtainable from Office of Technical Services, U.S.Dept. of Commerce, Washington, D.C., U.S.A.

For Pt II see Abstr. 4396 (1960). The reflectivity, transmission, and phase shift of evaporated layers up to 1000 A thick were measured at wavelengths of 540, 595, 620 and 700 mμ and the optical constants calculated. The results showed a dependence of the optical constants on thickness. The phase-shift depended on the form of the evaporation source used to prepare the layers. C.Hilsum

539.2 : 535

7993

THIN-LAYER OPTICS. IV. THE PROPERTIES OF GERMANIUM.

M.P.Lisitsa and N.G.Tsvelykh.

Optika i Spektrosk., Vol. 5, No. 5, 622-4 (1958).

Germanium layers were prepared by evaporation in vacuo. The reflection coefficients R (on the air side) and R' (on the substrate side) and the transmission coefficient T were measured at λ = 550-750 mμ. All measurements were made on freshly prepared layers. The transmission coefficient T was measured to within 5%. For R and R' the error did not exceed 10%. The dependences of R, R', T and A = 1 − R − T on the layer thickness (100-1000 A) are shown graphically. From the experimental values of T, R and R' the real (n) and imaginary (κ) parts of the complex refractive index $\tilde{n} = n - i\kappa$ were determined. A.Tybulewicz

539.2 : 535

7994

ABSORPTION INDEX [k] OF EVAPORATED FILMS OF MAGNESIUM FLUORIDE IN THE FAR ULTRAVIOLET.

D.Fabre and J.Romand.

C.R. Acad. Sci. (Paris), Vol. 250, No. 7, 1226-8 (Feb. 15, 1960). In French.

Values of k are determined from measurements of absorption and thickness. Values seem to depend on the supporting material and on age of the film; k increases with decreasing wavelengths to about 0.1-0.2 at λ = 1200 A. G.F.Lothian

539.2 : 535

7995

OPTICAL ABSORPTION BY FREE CARRIERS IN A SEMICONDUCTOR CONTAINING A DISPERSED COLLOIDAL PHASE.

B.R.Gossick.

J. appl. Phys., Vol. 31, No. 4, 648-9 (April, 1960).

For previous work see Abstr. 1633 (1960). The optical absorption by free carriers in a semiconductor containing a dispersed colloidal phase is treated, taking into account the dipolar diffusion of minority carriers about the particles.

539.2 : 535

7996

MEASUREMENT OF THE COEFFICIENT OF PHOTOELASTICITY OF GERMANIUM.

C.Grandjean and F.Desvignes.

C.R. Acad. Sci. (Paris), Vol. 250, No. 7, 1183-5 (Feb. 15, 1960). In French.

An arrangement for the study of the optical properties of silicon and of germanium is described. The coefficients of photoelasticity of germanium and silicon are 0.28 ± 0.03 and 1.97 ± 0.05 respectively. H.G.Jerrard

539.2 : 535

7997

PHOTON MOMENTUM EFFECTS IN THE MAGNETO-OPTICS OF EXCITONS.

J.J.Hopfield and D.G.Thomas.

Phys. Rev. Letters, Vol. 4, No. 7, 357-9 (April 1, 1960).

Magneto-absorption experiments were made on the 2p states of excitons at 1.6°K on platelets 5-10μ thick of CdS. The plane of the platelets contained the c axis; the normally incident light was polarized parallel to the c axis; the magnetic field H was perpendicular to the c axis and to the direction of propagation of the light. The relative intensities of the Zeeman lines vary drastically on reversing H. This can only be due to the finite wave-vector of light. A theory is sketched which agrees with the observations. A second possible effect of the photon momentum is indicated. L.Pincherle

539.2 : 535 : 539.3

PHOTOELASTIC COEFFICIENT OF ARALDITE MEASURED BY A CYCLIC DEFORMATION. See Abstr. 8109

539.2 : 535.3

7998 TIME VARIATIONS OF THE COEFFICIENT OF REFLECTION OF LIGHT FROM MECHANICALLY POLISHED METALS.

G.P.Skornyakov and K.A.Efremova.
Fiz. Metallov i Metallovedenie, Vol. 7, No. 3, 395-9 (1959).
In Russian.

The coefficients of reflection (R) of white and green light from Ni, Co, Fe and Cu standing in air were determined over a period of a week from the time of polishing. In the cases of Ni, Co and Fe no significant changes were observed in R nor in electron diffraction patterns of the surfaces. In the case of Cu the value of R fell by 2-3% in a week and the electron diffraction halos aquired a superimposed structure of diffuse lines. These changes are attributed to the formation and crystallization of Cu_2O. A.F.Brown

539.2 : 535.33

7999 A SIMPLE CLASSICAL MODEL OF THE ORGANIC EXCITON.

A.Ciais.
C.R. Acad. Sci. (Paris), Vol. 250, No. 7, 1243-5 (Feb. 15, 1960).
In French.

539.2 : 535.33

8000 ABSORPTION SPECTRA OF C_6H_6, C_6D_6 AND OF MIXED CRYSTALS (C_6H_6 + C_6D_6) AT 20°K.

A.Ciais and P.Pesteil.
C.R.Acad. Sci. (Paris), Vol. 250, No. 9, 1627-9 (Feb. 29, 1960).
In French.

Wavenumbers of maxima are tabulated for the region 37 800-39 000 cm^{-1} and discussed in relation to the classical theory of coupling given by Ciais (preceding abstract). The differing patterns of lines for C_6H_6 and C_6D_6 suggests that their structures are different. G.F.Lothian

539.2 : 535.33

8001 ABSORPTION SPECTRA OF MERCURY, BISMUTH AND ANTIMONY HALIDES IN PRESSED ALKALI HALIDE DISCS.

A.Glasner and R.Reisfeld.
J. chem. Phys., Vol. 32, No. 3, 956-7 (March, 1960).

Absorption curves for the range 200-400 mμ are given. Absorption develops during several days after mixing the powders, indicating that diffusion is taking place. G.F.Lothian

539.2 : 535.33

8002 INFRARED ABSORPTION OF ZINC OXIDE AND OF ADSORBED CO_2. I.

S.Matsushita and T.Nakata.
J. chem. Phys., Vol. 32, No. 4, 982-7 (April, 1960).

For measuring the absorption spectra of a powdered solid in contact with a gas and adsorbed gas molecules, a new disk technique has been developed by which the powder can be formed into optical samples having sufficiently high transmissivity and a well-defined thickness. By the use of this technique the spectrum of zinc oxide under varying heat treatments and gaseous conditions was studied at 20° and 300° C mainly in the region 2000 ~ ~ 1200 cm^{-1}. With samples made from zinc nitrate and evacuated at 3000° C a distinct symmetrical band was observed at 1550 cm^{-1} which was investigated in detail. From its intensity, behaviour and correlation with absorption by free electrons, the band was attributed to an electronic absorption associated with zinc vacancies in the crystal lattice. Samples made from zinc carbonate showed strong absorption by free electrons on being evacuated, affording a useful basis for observing its variation.

539.2 : 535.33

8003 INFRARED STUDIES OF CRYSTAL BENZENE. III. ASSIGNMENT OF 705 cm^{-1} BAND AND CRYSTAL SPLITTING OF ν_{11}.

W.B.Person and D.A.Olsen.
J. chem. Phys., Vol. 32, No. 4, 1268-9 (April, 1960).

For previous work, see Abstr. 2939 (1960). By using mixed crystal of C_6H_6 and C_6D_6 it has been conclusively demonstrated that the 705 and 687 cm^{-1} bands which occur in the spectrum of pure C_6H_6 are components of a correlation field doublet and not a combination tone. A similar explanation is afforded for the corresponding pair of bands at 514 and 497 cm^{-1} in C_6D_6. W.J.Orville-Thomas

539.2 : 535.33

8004 ABSORPTION AND REFLECTIVITY OF SEVERAL SEMI-CONDUCTORS IN THE GENERAL AND THE VACUUM ULTRAVIOLET.

S.Robin-Kandare.
J. Rech. Cent. Nat. Rech. Sci., No. 49, 311-57 (Dec., 1959).
In French.

The absorption and reflectivity of thin films, amorphous and crystalline, of elementary semiconductors Si, Ge, Te and Se was measured by various methods for specimens prepared under differ conditions. Reflectivity was measured in the spectral range 3000 to 1000 A and absorption over the range 3000 to 110 A. Attempts are made to interpret the absorption curves in terms of optical transitions relating to reduced energy diagrams. Data obtained from the reflectivity measurements and absorption bands due to internal tra sitions are used in the analysis. The results agree with experimen and point to the need for further detailed work. C.A.Hogart

539.2 : 535.3

8005 OPTICAL ABSORPTION IN GERMANIUM.

J.C.Phillips.
J.Phys. Chem. Solids, Vol. 12, No. 2, 208-9 (Jan., 1960).

The absorption spectrum of Ge from 1 to 10 eV (λ in range 0.1 to 1.2 μ) is analysed in terms of direct transitions and the band models proposed by Herman and by Phillips. C.A.Hogarth

539.2 : 535.3

8006 ELECTRIC FIELD INDUCED LIGHT ABSORPTION IN CdS.

R.Williams.
Phys. Rev., Vol. 117, No. 6, 1487-90 (March 15, 1960).

A shift of the band edge in CdS has been brought about by application of a high electric field to CdS crystals. High fields are produced at the rectifying junction between a conducting CdS crystal ar an electrolyte solution. A shift of the band edge of 70 A was observed for an applied e.m.f. of 120 volts. The effect is reversible and the absorption spectrum of the crystal after removing the field is identical with that before the field was applied. The absorption parallel to the crystal c axis and the absorption perpendicular to th c axis are affected in the same way by the applied field. The enhanc absorption at the band edge is believed to be the result of photon-assisted tunneling of electrons from valence band to conduction ban in the high-field region within the crystal.

539.2 : 535.3

8007 TEMPERATURE DEPENDENCE OF THE INFRARED REFLECTION SPECTRUM OF SODIUM CHLORIDE.

M.Hass.
Phys. Rev., Vol. 117, No. 6, 1497-9 (March 15, 1960).

Experimental studies of the reflection spectrum of NaCl from 300° K to 985° K were carried out in the region of the fundamental lattice absorption. This reflection spectrum was analysed using a simple dispersion formula. The damping constant deduced in this manner varied approximately with the square of the temperature. The relation of these results to various theories of lattice absorptio in solids is discussed.

539.2 : 535.3

8008 SPECTRA OF SODIUM AND POTASSIUM AZIDE CRYSTALS COLOURED BY ULTRA-VIOLET AND X-RAY RADIATION.

J.Cunningham and F.C.Tompkins.
Proc. Roy. Soc. A, Vol. 251, 27-40 (May 12, 1959).

The spectra of sodium and potassium azide crystals that had been coloured by irradiation with both ultraviolet and X-ray irradiati for varying periods at liquid nitrogen temperature have been recorded. From these results and from measurements of the rate of increase of intensity of the various absorption bands with time, together with the changes observed on raising the temperature, the nature and mechanism of formation of some of the centres are deduced. The different behaviour of the sodium and potassium salt under irradiation and the different effects produced by the two type of irradiation, particularly with the sodium salt, are discussed.

539.2 : 535.33 : 541.1

8009 PHOTOCHEMICAL BEHAVIOUR OF COMPLEXES CONTAINING OXYGEN IN ALKALI HALIDE CRYSTALS

F.Kerkhoff.
Z. Phys., Vol. 158, No. 5, 595-606 (1960). In German.

The optical absorption spectra of KCl, KBr and KI crystals wit small contents of hydroxyl ions and other oxygen complexes are measured before and after irradiation with unfiltered light from a hydrogen discharge lamp. The measurements extended from 180 to 800 mμ. At low temperatures, hydroxyl ions are photochemically di sociated into oxygen ions and hydrogen atoms at interstitial positio The hydrogen atoms are identified by paramagnetic spin resonance experiments similar to those of Delbecq, Smaller and Yuster on

Cl—KH crystals (Abstr. 2808 of 1957). The optical properties and he thermal stability of the interstitial hydrogen are discussed and ompared with earlier measurements on KH-doped crystals.

539.2 : 535.37

8010 LUMINESCENCE OF PURE AND SILVER-ACTIVATED ALKALI-HALIDES.
W.Maenhout-van Der Vorst.

Physica, Vol. 24, No. 12, 996-1008 (Dec., 1958).

A brief account is given of the luminescent properties of pure alkali halide crystals grown from the melt. It was shown that the so called "pure" crystals were mostly contaminated with oxygen. Oxygen ions accompanied by anion vacancies in the lattice were responsible for the blue or yellow emission when the crystals were excited with ultraviolet light. A study was also made of the luminescent behaviour of irradiated silver-activated alkali halides. The radiophotoluminescence is maximum at 120°C and shifts to shorter wavelength as the silver content increases.

539.2 : 535.37

8011 LOW-TEMPERATURE PHASE TRANSITIONS IN β-$Ca_3(PO_4)_2$ AND RELATED COMPOUNDS.
H Koelmans, J.J.Engelsman and P.S.Admiraal.

J. Phys. Chem. Solids, Vol. 11, No. 1-2, 172-3 (Sept., 1959).

When activated with Sn^{2+}, the β-compound excited by 2537 A radiation shows an arrest in the rise of luminescence between −35° and +10°C, and on cooling the steep fall from +10°C is arrested between −10° and −50°C. Calorimetric measurements confirmed the occurrence of two phase transitions in the phosphor or in the matrix without Sn, the sum of the heat effects being 1.7 kcal/mole or of the entropies 9.2 cal/deg C mole. Sr orthophosphates with small replacements of Mg, Zn, Ca, Cd or Al gave similar results.

S.T.Henderson

539.2 : 535.37

8012 POLARIZED EDGE EMISSION OF SiC.
W.J.Choyke, D.R.Hamilton and L.Patrick.

Phys. Rev., Vol. 117, No. 6, 1430-8 (March 15, 1960).

The photoluminescence of some relatively pure hexagonal SiC crystals (polytype 6H) includes a strongly polarized edge emission. Two distinct patterns of edge emission lines have been found, but never in the same crystal. In either type, the edge emission includes several narrow lines (half-width ~kT/4 at 77° K) and a number of wider bands spaced at regular energy intervals of 0.03 eV, suggestive of a vibrational interaction. Some lines, found in the 77° K edge emmission spectrum, vanish at 4° K. Mechanisms for producing polarized light are discussed, and it is concluded that the most probable luminescence centres are donor—acceptor pairs. The two types of spectra may be attributed to two different pairs. Intrinsic recombination radiation was looked for but not found.

539.2 : 535.37

8013 POLARIZATION OF THE LUMINESCENCE OF DONOR—ACCEPTOR PAIRS.
L.Patrick.

Phys. Rev., Vol. 117, No. 6, 1439-41 (March 15, 1960).

The polarization is calculated for donor—acceptor pair luminescence in SiC. Certain degrees of polarization depend only on the axial directions of the donor—acceptor pairs, thus permitting one to identify emission by such centres in SiC, or in other uniaxial crystals with tetrahedral bonds. A comparison with experiment is inconclusive because of insufficient resolution. The Prener—Williams conclusion about nearest-neighbour donor—acceptor pairs are discussed.

539.2 : 535.37

8014 CRYSTAL FLUORESCENCE OF CARCINOGENS AND RELATED ORGANIC COMPOUNDS.
J.B.Birks and A.J.W.Cameron.

Proc. Roy. Soc. A, Vol. 249, 297-317 (Jan. 13, 1959).

The crystalline fluorescence spectra of 41 organic compounds, including 29 known carcinogens, have been observed, when excited by 254 mμ radiation. For anthracene, 1 : 2-benzanthracene and other compounds, a correction has been made for self-absorption, and the molecular fluorescence spectra have been derived. In the 1 : 2-benzanthracene derivatives, a sequence of spectral types is observed, ranging from type A, with a vibrational structure similar to the spectrum of the parent compound, to type E, with a single broad, diffuse band and a major bathochromic shift. The effect is attributed to molecular interaction in the crystal. The molecular photofluorescence decay times of 32 of the compounds are reported.

539.2 : 535.37

8015 AN ANALYSIS OF THE FLUORESCENCE SPECTRUM OF NEODYMIUM CHLORIDE.
B.R.Judd.

Proc. Roy. Soc. A, Vol. 251, 134-42 (May 12, 1959).

See also Abstr. 7686 (1960). It is assumed that the effect of the surroundings of a neodymium ion in the trichloride lattice on the 4f electrons can be reproduced by a static electric field. The electric potential is expanded in a series of spherical harmonics; because of the point symmetry C_{3h}, only four terms are required. The observed splittings of $^4I_{9/2}$, $^4I_{11/2}$ and $^4I_{13/2}$ are fitted to within 2.5 cm^{-1} by varying the coefficients of the four spherical harmonics. The coefficients obtained thereby are compared to the corresponding ones for $PrCl_3$, and the importance of configurational interaction is discussed. Intermediate coupling effects and crystal field interactions between the levels are taken into account in the calculations.

539.2 : 535.37

8016 THE LUMINESCENCE OF THALLIUM-ACTIVATED POTASSIUM CHLORIDE PHOSPHORS.
J.Ewles and R.V.Joshi.

Proc. Roy. Soc. A, Vol. 254, 358-71 (Feb, 23, 1960).

Describes and discusses new experimental investigations of the excitation, absorption and emission spectra, phosphorescent decay curve characteristics, thermoluminescence and photoconductivity of potassium chloride phosphors activated by thallium and of the thermoluminescence of potassium chloride phosphors activated by barium, by strontium or by thermal or mechanical strains. It is concluded that for concentrations of more than about 0.001 mole Tl the KCl:TlCl phosphors contain a number of different centres. Reasons are given for suggesting that some of these may be: (1) Tl^+ ions at substitutional sites and not near to other Tl^+ ions at neighbouring positive ion sites; (2) $TlCl_n$ complexes at special sites near defects or along dislocations; (3) lattice distortions produced by the incorporation of Tl^+ or other foreign ions. Since the main emission peaks appearing in the thermoluminescence of KCl:Tl at 200° and 300° K also occur in the KCl phosphors activated by barium, by strontium or by thermal or mechanical strain, it would appear that the electron traps responsible for the phosphorescence of KCl:Tl cannot be, as Williams suggests, metastable levels in Tl ions. It is suggested that they are at lattice defects created either by Tl or other foreign ions or by thermal or mechanical strains. The complexity of the absorption, emission and excitation spectra suggest that existing theories of the luminescence of KCl:Tl require further development.

539.2 : 535.37

8017 THE LUMINESCENCE OF THE COMPLEX FLUORIDES.
K.T.Wilke, K.Albers and R.Mannheim.

Z. phys. Chem. (Leipzig), Vol. 213, No. 3-4, 191-224 (1960).
In German.

A review of previous work with some new experimental results on fluoride phosphors, including double fluorides of alkalis, alkaline earths, and Al, Si, and Sn; also other systems including Al_2O_3, SiO_2, MgO, CaO, TiO_2 and V_2O_5. Activators considered are Mn, Ti, Ce, Pb and Bi. Details given include preparation methods, spectral curves of the luminescence under cathode rays or ultraviolet, and crystal structure.

S.T.Henderson

539.2 : 535.37 : 537.2

PHOTODIELECTRIC PHENOMENON IN LUMINESCING ZINC CADMIUM SULPHIDES. See Abstr. 6158

539.2 : 535.37 : 532.7

8018 MAXIMUM POLARIZATION OF FLUORESCENCE.
A.N.Sevchenko, G.P.Gurinovich and A.M.Sarzhevskii.

Dokl. Akad. Nauk SSSR, Vol. 126, No. 5, 979-82 (June 11, 1959).
In Russian.

See Gurinovich and Sevchenko [Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 22, No. 11, 1407-11 (1958)]. In order to eliminate the effect of Brownian movement, investigations were carried out with solid solutions of phthalimide in polymethylmethacrylate (concentration 5×10^{-6} g cm^{-3}); solutions in glycerol were also studied. It was found that the absolute value of the degree of polarization increases mar markedly as one approaches the frequency of pure electron transition (for both the positive and negative polarization values). In most cases the function $P_0 = f(\nu_{exc})$ has a mirror symmetry with respect to the function $P_0 = f(\nu_{emiss})$; the absolute value of the degree of polarization, when the exciting light has the frequency $\nu_{exc} = \nu_{el}$, has in solid solutions (when fluorescence of the same frequency is observed) very often a value close to theory (0.5). An attempt is made to explain the observed deviations from 0.5.

F.Lachman

539.2 : 535.37

8019 THE AFTERGLOW OF NaCl RECRYSTALLIZED PHOSPHORS ACTIVATED WITH TlCl. Z.Morlin.

Acta phys. Hungar., Vol. 7, No. 3, 341-5 (1957). In German.

NaCl and TlCl crystallized together from a melt, and excited to saturation by ultraviolet, show an exponential decay, but if a mixed solution is evaporated and the dried powder compressed to a tablet, this shows hyperbolic decay after excitation. Data are given on the variation of light sum S with Tl concentration and its fall with time after compression of the material. A minimum value of S is obtained by heating to 200-300°C after cold pressing, but at higher temperature recovery occurs. Pressing at different temperatures produces a minimum value of S at 400°C. Effects on decay curves of Tl concentration and heating procedures are described.
S.T.Henderson

539.2 : 535.37

8020 EFFECT OF PRESSURE ON PHOSPHOR DECAY. D.W.Gregg and H.G.Drickamer.

J. appl. Phys., Vol. 31, No. 3, 494-6 (March, 1960).

An apparatus has been developed to measure the effect of pressure to over 50 000 atm on the decay rate of phosphors. Three manganese activated phosphors with exponential decay curves were studied. In two cases the rate of decay decreased, in the third case it increased. A tentative explanation is offered. A hexagonal ZnS:Cu phosphor showed little pressure effect to 40 000 atm at which pressure it transformed irreversibly to the cubic form with a sharp increase in decay rate and a large decrease in intensity.

539.2 : 535.37

8021 THE PHYSICO-CHEMICAL NATURE OF CANDOLUMINESCENCE. A.N.Gorban' and V.A.Sokolov.

Optika i Spektrosk., Vol. 7, No. 2, 259-61 (Aug., 1959). In Russian.

Sokolov (Abstr. 4427 of 1960) suggested that one of the main causes of candoluminescence (luminescence in flames) is absorption by the phosphor of energy liberated in recombination, on the phosphor surface, of atoms and radicals into molecules. This suggestion was confirmed by the following experiment. Since recombination of atoms and radicals occurs readily on metal surfaces, introduction of a metal grid into a flame together with a phosphor should depress the latter's luminescence, because the majority of recombinations would then occur on the metal grid. It was found that a copper grid placed in a Bunsen flame in such a way as to make the flame pass through the grid before reaching the phosphor weakens candoluminescence of the phosphor very considerably. A.Tybulewicz

539.2 : 535.37

8022 ARRANGEMENT FOR STUDY OF LUMINESCENT SUBSTANCES UNDER THE ACTION OF CATHODIC BOMBARDMENT. F.Gans.

C.R. Acad. Sci. (Paris), Vol. 250, No. 10, 1821-3 (March 7, 1960). In French.

The phosphor is on a rapidly rotating disc of glass or metal, and the electron beam focused on a point away from the axis of rotation. S.T.Henderson

539.2 : 535.37

8023 SCINTILLATION RESPONSE (LIGHT YIELD) OF ANTHRACENE TO LOW-ENERGY [< 200 keV] POSITRONS AND ELECTRONS.

K.Gubernator, P.H.Heckmann and A.Flammersfeld.

Z. Phys., Vol. 158, No. 3, 268-73 (1960). In German.

The response was found to be linear within experimental error, with an intercept on the energy axis of a few keV, depending on size and surface conditions of the crystal. The light yield of positrons might be slightly below that of electrons, but the difference is less than about 2%.

539.2 : 535.37

8024 ON THE ELECTROLUMINESCENCE OF INSULATED SiC CRYSTALS. J.Weiszburg.

Acta phys. Hungar., Vol. 11, No. 1, 95-6 (1960).

Electroluminescence was observed in crystals of SiC unaccompanied by the usual rectifying effect. The light was emitted when the specimen was separated from one of the electrodes by a mica sheet, requiring an average field of about 10^6 V cm^{-1} a.c. or 20 times the field necessary to produce the same colour, distribution and intensity without the mica. This is interpreted as meaning that the electrons causing the light are supplied by surface states rather than by injection from the electrodes, so that SiC electroluminescence can be likened to that of ZnS. I.Cooke

539.2 : 535.3

8025 THE EFFECT OF ULTRASONIC IRRADIATION ON ELECTROLUMINESCENT PANELS.

J.Weiszburg and P.Greguss, Jr.

Acta phys. Hungar., Vol. 11, No. 2, 185-91 (1960).

It was found that electroluminescent panels in an ultrasonic fiel showed a yellow discoloration, the degree of which depended on the intensity of the ultrasonic field. This effect can be interpreted by the alteration of field strength within the electroluminescent panel due to its local heating.

539.2 : 535.37

8026 THE ROLE OF EXHAUSTION BARRIERS IN ELECTROLUMINESCENT POWDERS. G.Diemer and P.Zalm.

Physica, Vol. 25, No. 3, 232 (March, 1959).

Exhaustion barriers can cause local enhancement of the electri field in insulated electroluminescent crystals, provided that electro luminescent emitting spots are small compared with the local electrode area. J.Franks

539.2 : 535.37

8027 THE INFLUENCE OF THE EXCITATION WAVELENGT ON ELECTROPHOTOLUMINESCENCE.

H.Gobrecht and H.E.Gumlich.

Z. Phys., Vol. 158, No. 2, 226-41 (1960). In German.

The energy level structure of ZnS:Mn and its luminescent and non-radiative transitions are discussed. Excitation spectra are given for the Mn band and the lattice band at Mn concentration between 10^{-2} and 10^{-5} by weight. The yellow emission is enhanced by an electric field if the ultraviolet excitation is absorbed in the lattice band, while quenching is caused if excitation occurs in the long wavelength tail of the lattice absorption; the field has no effect if the ultraviolet is absorbed directly by the Mn ions. The blue emission is decreased by the field whether excitation is above or below the absorption edge. The mechanism is discussed in terms of energy transport in the ZnS lattice. S.T.Henderson

539.2 : 535.37

8028 THERMOLUMINESCENCE SPECTRA OF LiF. A.K.Ghosh and B.C.Dutta.

Indian J. Phys., Vol. 32, No. 1, 47-8 (Jan., 1958).

LiF, excited with 10 kV at 90°K, gave glow peaks at 140° and 650°K. The first glow peak maximum was at 435 mμ and the second at 597 mμ. J.Franks

MAGNETIC PROPERTIES OF SOLIDS

539.2 : 538.2

8029 ON THE PROBLEM OF MAGNETIC SUSCEPTIBILITY OF METALLIC LITHIUM.

A.G.Samoilovich and M.V.Nitsovich.

Fiz. tverdogo Tela, Vol. 2, No. 2, 341-3 (Feb., 1960). In Russian.

Based on a general expression for the orbital magnetic susceptibility of electron gas in a crystal, obtained by Nitsovich (Abstr. 6212 of 1960), formulae for calculating magnetic susceptibility of metallic Li are derived. M.H.Sloboda

539.2 : 538.

8030 PARAMAGNETIC SUSCEPTIBILITY OF POLYCRYSTALLINE THULIUM FROM 300 to 1500°K.

S.Arajs.

J. chem. Phys., Vol. 32, No. 3, 951-2 (March, 1960).

This has been measured by the Faraday method; the Weiss—Curie law is satisfied by the results, with a paramagnetic Curie temperature of 17.4 ± 0.5°K, and an effective Bohr magneton number of 7.68 ± 0.10. Agreement with low-temperature measurements is satisfactory. J.Hawgood

539.2 : 538.2

8031 A DISPERSION FUNCTION OF PARAMAGNETIC RELAXATION. P.H.Fang.

Physica, Vol. 24, No. 12, 970-4 (Dec., 1958).

An empirical dispersion function for paramagnetic relaxation is proposed which is intended to describe experimental data for the magnetic susceptibilities of some alums. This function gives an asymmetric frequency spectrum of the complex susceptibilities. The characteristics of the distribution of the relaxation time of this function are discussed. See also Abstr. 3855 (1938).

539.2 : 538.2

8032 PARAMAGNETISM WITHOUT KRAMERS DEGENERACY.

B.Bleaney.

Physica, Vol. 24, Supplement, S78 (Sept., 1958).

Low Temperature Physics Conference (see Abstr. 7017 of 1960). Brief note, substantially as follows: In substances where the paramagnetic ion has an even number of electrons, a twofold degeneracy of the lowest energy levels may remain if the crystal field has axial symmetry. Random deviations of the crystal field from this symmetry will then cause a splitting of the doublet ground state which varies from ion to ion. This will produce effects on the paramagnetic resonance spectrum, the specific heat, the susceptibility and the nuclear alignment.

539.2 : 538.2

8033 ON THE MAGNETIC SUSCEPTIBILITY AND ANISOTROPY OF V^{3+} UNDER A CRYSTALLINE ELECTRIC FIELD HAVING PREDOMINANTLY CUBIC SYMMETRY WITH A SMALL TRIGONAL COMPONENT.

A.S.Chakraborty.

Indian J. Phys., Vol. 41, No. 9, 447-9 (Sept., 1958).

A new expression for the susceptibility as a function of temperature has been derived, the earlier expression being based on assumptions now known to be incorrect. The results are compared with a recent series of measurements. R.C.Kell

539.2 : 538.2

8034 THE NATURE OF THE CRYSTALLINE FIELDS IN Ti^{3+} ALUM.

A.Bose, A.S.Chakravarty and R.Chatterjee.

Proc. Roy, Soc. A, Vol. 255, No. 1280, 145-51 (March 22, 1960).

A theory of susceptibility for titanium caesium alum is given. The crystalline field in this alum is treated on the molecular orbital method of Stevens and others, as the usual electrostatic field theory is found to fail to explain the magnetic behaviour. Experimental susceptibility data between 300° and 100°K as well as the paramagnetic resonance data at 2.5°K can all be accounted for satisfactorily by assuming that the trigonal field splitting changes from 800 to ~ 170 cm^{-1}, with temperature, which is also indicated by the large observed increase in the spin–lattice relaxation time from 300° to 1.2°K.

539.2 : 538.2

8035 MAGNETIC SUSCEPTIBILITIES OF CHROMIUM RUBIDIUM ALUM BELOW 1°K.

J.A.Beun, A.R.Miedema and M.J.Steenland.

Physica, Vol. 25, No. 5, 399-405 (May, 1959).

Adiabatic demagnetization measurements are performed on a third chromium alum, CrRb alum. The behaviour of the susceptibility in external magnetic fields is compared with that of CH_3NH_3 alum and K alum.

539.2 : 538.2

8036 SPIN CONFIGURATIONS.

F.Bertaut.

C.R. Acad. Sci (Paris), Vol. 250, No. 1, 85-7 (Jan. 4, 1960). In French.

Two methods are given for finding ordered spin configurations which minimize the exchange energy in a crystal. Applications to various crystals are reported. D.M.Edwards

539.2 : 538.2

8037 EFFECT OF CRYSTALLOGRAPHIC TWINS ON THE D.C. AND A.C. PROPERTIES OF NICKEL–IRON ALLOYS.

J.E.Thompson.

Brit. J. appl. Phys., Vol. 10, No. 12, 511-16 (Dec., 1959).

A number of alloys of nickel–iron (equal parts) have been prepared from pure materials by powder metallurgy techniques. The degree of cold rolling and the annealing temperature have been varied in an attempt to obtain the optimum magnetic properties in the material after magnetic annealing. It has been found that crystallographic twins of varying number, length and thickness are produced during the annealing process. The effect of these twins on the coercive force and alternating total loss is discussed.

539.2 : 538.2

8038 ON THE CALCULATION OF THE PARTITION FUNCTION OF A FERROMAGNETIC CRYSTAL.

W.Opechowski.

Physica, Vol. 25, No.6, 476-86 (June, 1959).

It is shown that, by modifying Kramers' approximate method of calculating the partition function of a ferromagnetic crystal, one obtains, in a straightforward and simple way Dyson's extension (Abstr. 5998-9 of 1956), of Bloch's formulae (Abstr. 2925 of 1930), for the free energy and the spontaneous magnetization at low temperatures. Within its limited region of validity, the modified Kramers' method is thus exactly equivalent to Dyson's spin-wave method.

539.2 : 538.2 : 621.318.132

8039 THE INFLUENCE OF THE METHOD OF DEMAGNETIZATION ON THE REVERSIBLE PERMEABILITY OF A HIGH-PERMEABILITY NICKEL–IRON ALLOY.

R.C.Jackson, E.W.Lee and A.G.H.Troughton.

Brit. J. appl. Phys., Vol. 9, No. 12, 495-7 (Dec., 1958).

Measurement of the reversible permeability of a high-permeability nickel–iron alloy shows that its dependence upon biasing field depends upon the method of demagnetization used. Results are found to be partially explicable in terms of residual magnetization, some specimens possessing residual magnetization even after a high-temperature anneal.

539.2 : 538.2

8040 DIPOLAR FERROMAGNETISM IN DYSPROSIUM ETHYL SULPHATE.

A.H.Cooke, D.T.Edmonds, C.B.P.Finn and W.P.Wolf.

Proc. Phys. Soc., Vol. 74, Pt 6, 791-3 (Dec., 1959).

Low temperature measurements of the magnetic properties of dysprosium ethyl sulphate show that this substance undergoes a transition at $0.13_6 \pm 0.01$°K, below which the susceptibility is independent of temperature. This transition is attributed to the onset of ferromagnetism produced by dipole-dipole coupling between Dy^{3+} ions which lie in chains along the crystal axis. Each chain has three nearest neighbour chains, and the dipolar interaction between chains favours ferromagnetic alignment. Calculation shows that the energy of domain walls in the demagnetized state is small and domain thicknesses are estimated as 10^{-4}cm. The volume susceptibility of a specimen is thus the reciprocal of its demagnetizing factor. These considerations were found to be in good accord with experiment for a spherical and an ellipsoidal specimen. R.Parker

539.2 : 538.2 : 551.5

8041 EXCHANGE ANISOTROPY IN ROCK MAGNETISM.

W.H.Meiklejohn and R.E.Carter.

J. appl. Phys., Vol. 30, No. 12, 2020 (Dec., 1959).

A solid solution of 0.6 $FeTiO_3$–0.4 Fe_2O_3 was found to have a displaced hysteresis loop after cooling in a magnetic field. This is adduced as additional evidence that the reverse thermo-remanent magnetization of the Haruna deposit in Japan, investigated by Uyeda [Japan. J. Geophys., Vol. 2, No. 1 (1958)] is due to a magnetic phenomenon and not to reversal of the earth's magnetic field. A.J.Manuel

539.2 : 538.2 : 621.318.132

8042 FERROMAGNETIC AFTER-EFFECT IN MUMETAL.

L.Castelliz and W.W.H.Clarke.

Brit. J. appl. Phys., Vol. 10, No. 3, 142-7 (March, 1959).

Study of the magnetic performance of Ludlam mumetal sheets incorporated in extremely precise deflection yokes has revealed a magnetic after-effect having a magnitude and decay time which appear to place it in a different category from reported phemomena of this general nature. This paper describes the phenomenon, which has been measured,and includes a description of the mechanism which is believed to be responsible for it. The effect is partially submerged by the well-known eddy current delay, measurements of which have also been made. The dependence of both after-effects on various parameters such as annealing treatment, thickness and spacing of the mumetal sheets and temperature, has been revealed qualitatively by the experiments, and it is the difference in their behaviour under these parametric variations which has enabled them to be properly distinguished.

539.2 : 538.2

8043 USE OF THE VARIATIONAL PRINCIPLE TO DETERMINE BASIC PROPERTIES OF A FERROMAGNETIC FROM ITS HYSTERESIS LOOP.

V.I.Skobelkin.

Dokl. Akad. Nauk SSSR, Vol. 130, No. 5, 1012-14 (Feb. 11, 1960). In Russian.

The formulated theory enables a quantitative characterization of the hysteresis loop and correlates several characteristic properties of a given ferromagnetic with the shape of the loop. J.K.Skwirzynski

539.2 : 538.2

8044 ROTATIONAL HYSTERESIS LOSS IN GRAIN-ORIENTED SILICON-IRON.

W.F.Archenhold, H.F.Sandham and J.E.Thompson.

Brit. J. appl. Phys., Vol. 11, No. 1, 46-9 (Jan., 1960).

An improved torque magnetometer has been used to measure accurately the rotational hysteresis loss in grain-oriented silicon—iron for various percentage orientations and thicknesses. The experimental results are discussed in terms of multi-domain concepts and of the Stoner—Wohlfarth single-domain particle (Abstr. 1877 of 1948), of which the rotational-hysteresis behaviour has been evaluated. The possible relevance of this theory and its extensions to the experimental results are considered.

539.2 : 538.2

8045 MAGNETIC DOMAIN PATTERN OF A COBALT POLYCRYSTAL. (I). Y.Takata.

J. Coll. Arts Sci. Chiba Univ., Vol. 2, No. 3, 268-70 (March, 1959). In Japanese.

The domain pattern of the plane parallel to the c axis of a cobalt single crystal, cut from polycrystal, was observed and photographed by the powder pattern method. Experimental data on the domain wall width and crystal depth was compared with the theoretical domain width calculated to minimize the total energy (wall energy, demagnetizing energy and interaction energy). The results roughly coincide.

539.2 : 538.2

8046 INTERNAL STRESSES IN INFINITE, LAMINATED, ANISOTROPIC ELASTIC MEDIA, WITH SPECIAL REFERENCE TO WEISS DOMAINS IN LAMINATED PLATES.

G.Rieder.

Abhandl. Braunschw. Wiss. Gesell., Vol. 11, 20-61 (1959). In German.

The differential equations for the internal stresses are specialized for one independent variable only; their solution may be reduced, for given additional stresses and strains, to quadratures and algebraic calculations. The formulae obtained are used to compute the magnetostrictive internal stresses in the Weiss domains and Bloch walls of ferromagnetic single crystals. The behaviour of a plate of finite thickness is investigated, and possibilities of measuring internal stresses in stratified anisotropic plates (e.g. metal-clad sheets or plywood) are discussed.

539.2 : 538.2

8047 EXTERNAL FIELDS FROM DOMAIN WALLS OF COBALT FILM.

B.Kostyshyn, J.E.Brophy, I.Oi and D.D.Roshon, Jr.

J. appl. Phys., Vol. 31, No. 5, 772-5 (May, 1960).

By scanning the surface with a Hall probe, domain patterns on thin cobalt films have been mapped by measuring the fringing flux normal to the film surface. The samples studied were cobalt approximately 2000 A thick. At the domain boundaries, peak fields ranged in intensity from less than 0.5 to 4.5 Oe. The probe-to-film gap was 13 μ. The sensitive area of the probe was a square of bismuth 20 μ on a side. It was observed that along specific boundaries, reversal of flux direction occurs. The boundaries exhibiting low peak fields were generally parallel to the easy direction of magnetization, whereas the boundaries exhibiting high fields were skewed relative to the easy direction of magnetization. Kerr effect and Hall probe patterns for the same domain configuration are shown to agree.

539.2 : 538.2

8048 180° DOMAIN WALL ORIENTATION IN IRON. T.Harada and E.Tatsumoto.

J. Sci. Hiroshima Univ. A, Vol. 23, No. 2, 195-200 (Dec., 1959).

Graham and Neurath have calculated the stable orientation of a 180° domain wall in a cubic crystal with ⟨100⟩ easy directions as a function of crystal orientation for a sheet specimen with a ⟨100⟩ direction parallel to the surface. If the crystal surface is a {100} plane, the domain wall lies at right angle to the surface. However, if the crystal plane is a {110} plane, there are two equivalent stable domain positions, with the wall making an angle of ±32° with the normal to the specimen surface. Their calculation was ascertained to be expedient and reasonable, by observing the stable domain orientation in single crystal strips of iron and 1.08% silicon iron which have a ⟨100⟩ direction parallel to the lengthwise direction.

539.2 : 538.2

8049 EXPERIMENTAL AND THEORETICAL STUDY OF THE DOMAIN CONFIGURATION IN THIN LAYERS OF $BaFe_{12}O_{19}$. C.Kooy and U.Enz.

Philips Res. Rep., Vol. 15, No. 1, 7-29 (Feb., 1960).

With the aid of the optical Faraday effect, the domain configuration and the magnetization process in thin transparent monocrystalline plates of $BaFe_{12}O_{19}$ are studied. The plates have surfaces parallel to the basal plane of the hexagonal structure. The domain pattern consists of line-shaped domains. The domain width is measured as dependent on the applied magnetic field parallel to th c-axis. The width of a reversed domain decreases slowly with the applied field reaching a finite thickness near saturation, whereas the width of a domain magnetized in the direction of the applied fie increases rapidly near saturation. At this stage the remaining reversed line-shaped domains contract towards cylindrical domains which collapse at slightly higher fields. Saturation is reached in a field well below $4\pi I_s$. The demagnetizing energy of a partly magne ized thin uniaxial crystal having the easy axis normal to the surfac is calculated for a domain pattern consisting of straight parallel domains. The stable configuration for a given value of the magneti field is obtained by minimizing the total energy. The solution is obtained in the form of two simultaneous equations containing the two different domain widths, which are evaluated by an electronic computer. Theoretical magnetization curves are deduced. The general accordance between experiment and theory is good.

539.2 : 538.

8050 DOMAIN STRUCTURES ON THIN SHEETS OF MAGNET PLUMBITE. E.D.Isaac.

Proc. Phys. Soc., Vol. 74, Pt 6, 786-8 (Dec., 1959).

For a section of thickness 25μ the pattern exhibited a "rick-rack" structure, and for one of thickness 6μ the structure was of straight 180° walls, as expected on magnetostatic grounds.

E.P.Wohlfa

539.2 : 538

8051 INVESTIGATIONS ON THE DOMAIN STRUCTURE IN HEMATITE BY MEANS OF THE ELECTRON BEAM METHOD. M.Blackman, G.Haigh and N.D.Lisgarten.

Proc. Roy. Soc. A, Vol. 251, 117-26 (May 12, 1959).

Shadow patterns have been obtained from crystals of hematite using the electron beam technique. These patterns possess shado edge features which are shown to be consistent with that to be expected from a domain structure. In many of the crystals examine the features disappear on cooling at about −15° C and reappear on heating. In a number of cases of crystals containing relatively lar amounts of impurities, particularly titanium, the shadow-edge features either do not change, or disappear only at appreciably lo temperatures.

539.2 : 538

8052 THE RELAXATION OF FERROMAGNETIC DOMAIN WALLS. B.Rothenstein.

Z. Naturforsch., Vol. 15a, No. 2, 169-71 (Feb., 1960). In German.

Under specified assumptions the square of the velocity of a domain wall is proportional to the internal friction exhibited by a ferromagnetic in an a.c. magnetic field. Curves are given for an iron wire of the ratio v_f/v_{200} against the frequency of the applied magnetic field in the range of 20 to 200 c/s; v_f represents the velocity of a wall at the field frequency f, and v_{200} that at 200 c/s. For a given amplitude of the driving field the ratio drops monotonically with increasing frequency, indicating the existence of a velocity maximum for the walls between 0 and 20 c/s. R.Park

539.2 : 538

8053 OBSERVATIONS OF NÉEL WALLS IN THIN FILMS. H.Rubinstein, H.W.Fuller and M.E.Hale.

J. appl. Phys., Vol. 31, No. 2, 437-8 (Feb., 1960).

These are walls in which the magnetization rotates in the plan of the film, and they were observed in an anisotropic 450 A permalloy film using powder patterns and magnetic fields applied in different directions.

E.P.Wohlf

539.2 : 538

8054 MEASUREMENTS OF THE COERCIVE FORCE OF THIN FILMS OF THE FERROMAGNETIC METALS.

A.Dupré.

Verhandl. K. Vlaamse Acad. Wetensch., No. 59, 62 pp. (1959). In Flemish.

The coercive force H_c of evaporated nickel and cobalt films was obtained from magnetoresistance measurements. The dependence of H_c on the angle ϕ between the directions of the applied field and the film normal is approximately as cosec ϕ. The tempe ture variation of H_c was measured between 1.5° and 290° K and found to be as $\exp(-\beta T^{1/2})$. Measurements are also reported for rolled sheets of nickel, cobalt and iron. E.P.Wohlfa

539.2 : 538.2 : 536.48

POSSIBLE EXPLANATION OF THE "COEXISTENCE" OF FERROMAGNETISM AND SUPERCONDUCTIVITY. See Abstr. 7030

539.2 : 538.2

8055 FORM EFFECT IN MAGNETOSTRICTION. R.Gersdorf.

J. appl. Phys., Vol. 30, No. 12, 2018-19 (Dec., 1959).

Attention is drawn to differences in the results of calculations by Stauss (Abstr. 7166 of 1959) and those of the author which confirm and extend Becker's results. A calculation of the form effect for a rotation ellipsoid, applying the principle of virtual work more rigorously than Stauss, leads to results which agree in special cases with earlier work. A.J.Manuel

539.2 : 538.2

8056 THE SATURATION MAGNETOSTRICTION OF POLYCRYSTALS. R.R.Birss.

Proc. Phys. Soc., Vol. 75, Pt 1, 8-16 (Jan., 1960).

Relations between the single-crystal and polycrystalline saturation magnetostriction constants are derived for cubic materials of positive and negative anisotropies. Terms which are independent of the direction in which the magnetostrictive strain is measured are not neglected and the formulae obtained are thus directly applicable to the corresponding magnetoresistance constants. The method used is perfectly general and is extended to deal with materials of hexagonal (and cylindrical) symmetry for which the hexagonal axis is a direction of easy magnetization or for which the basal plane is a plane of easy magnetization. The relations obtained are compared with experimental data.

539.2 : 538.2 : 534.27

8057 ROTATION OF THE PLANE OF POLARIZATION OF ELASTIC WAVES BY MAGNETICALLY POLARIZED METALS. K.B.Vlasov.

Fiz. Metallov i Metallovedenie, Vol. 7, No. 3, 447-8 (1959). In Russian.

Changes in the electron distribution due to an applied magnetic field result in a force which rotates the plane of polarization of an elastic wave through an angle χ. Calculations give $\chi \sim 10^{-4}$ radians per cm thickness of the crystal per oersted. A.F.Brown

539.2 : 538.2

8058 ON THE POSSIBILITY OF MODIFYING THE MAGNETIC PROPERTIES OF FERROMAGNETIC BODIES BY NEUTRON IRRADIATION. A.Drigo.

Energia elett., Vol. 36, No. 7, 617-21 (July, 1959). In Italian.

A review and discussion of existing experimental results. L.Pincherle

539.2 : 538.2 : 621.317.41

8059 RESONANT CAVITY METHODS OF MEASURING FERRITE PROPERTIES. R.A.Waldron.

Brit. J. appl. Phys., Vol. 9, No. 11, 439-42 (Nov., 1958).

Formulae are given for the frequency shift on introducing a ferrite sample into a resonant cavity. Cylindrical rod, circular disk, and spherical samples are considered; the sample may be placed in a region of zero electric or magnetic field, enabling magnetic and dielectric properties to be separately determined. The merits and demerits of the various sample shapes are discussed, and it is concluded that a spherical sample is usually best; in particular, with such a sample, the dielectric constant and permeability can be measured on the same sample, in the same cavity, working in the same mode.

539.2 : 538.2

8060 ELECTROMAGNETIC FIELDS IN FERRITE ELLIPSOIDS. R.A.Waldron.

Brit. J. appl. Phys., Vol. 10, No. 1, 20-2 (Jan., 1959).

The derivation of the field in a ferrite, when immersed in a uniform field, from a knowledge of the demagnetizing factors is logically unjustifiable, since these quantities depend on a knowledge of the internal fields. The internal fields must logically be calculated from the magnetic potential equation by the application of suitable boundary conditions. Results of such calculations are given for spheres, rods of circular or elliptical cross-section, longitudinally or transversely polarized, and disks polarized perpendicularly or parallel to their planes. The demagnetizing factors are also deduced from the fields.

539.2 : 538.2

8061 DIFFUSION LAG IN IRON-RICH NICKEL-ZINC FERRITES. A.Marais and T.Merceron.

C.R.Acad. Sci. (Paris), Vol. 249, No. 23, 2511-13 (Dec. 9, 1959). In French.

Maxima in the loss tangents and permeabilities occur in three temperature regions within the range -200° to 350° C, and are affected by the composition of the ferrite. The three relaxation phenomena are ascribed respectively to electronic exchange between ions in similar lattice sites, electronic exchange between ions in different sites, and ionic diffusion aided by vacancies. The diffusion results in preferred directions of magnetization, which are retained by rapid cooling in a magnetic field and give rectangular hysteresis loops. R.C.Kell

539.2 : 538.2 : 548.5

VERNEUIL-GROWN FERRITE MONOCRYSTALS. See Abstr. 6327

539.2 : 538.2

8062 THEORY OF MAGNETIC-MOMENT RELAXATION IN FERROMAGNETIC DIELECTRICS. V.G.Bar'yakhtar.

Zh. eksper. teor. Fiz., Vol. 37, No. (9), 690-4 (Sept., 1959). In Russian. English translation in: Soviet Physics — JETP (New York), Vol. 37, (10), No. 3, 493-6 (March, 1960).

The relaxation of magnetic moment and the equalization of temperatures between spin waves and the lattice are investigated at low temperatures $T \ll \Theta_C$. For $T \gg \Theta_1$, $\Theta_1 = \Theta_C(\mu M_0/\Theta_C)^{4/7}$ a Bose distribution corresponding to the nonequilibrium magnetic moment is first set up, then the equilibrium value of the magnitude of the magnetic moment is established and, finally, a rotation of the magnetic moment to its equilibrium direction occurs. For $T \ll \Theta_1$, the magnetic moment assumes its equilibrium value simultaneously with the establishment of the Bose distribution of the spin waves, and then the magnetic moment rotates to its equilibrium direction. Simple formulae are obtained which describe the temperature equalization of the spin waves and the lattice, and the relaxation of the magnetic moment.

539.2 : 538.2

8063 MAGNETIC BEHAVIOUR OF A SPIRAL ANTIFERROMAGNETIC. A.Herpin and P.Mériel.

C.R. Acad. Sci. (Paris), Vol. 250, No. 8, 1450-2 (Feb. 22, 1960). In French.

Reports a neutron diffraction study of the influence of a magnetic field on the magnetic structure of $MnAu_2$. The structure in the absence of a field was described earlier (Abstr. 1818 of 1960) but the angle between magnetic moments in successive planes perpendicular to the c-axis was wrongly reported as 102° instead of 51°. It is found that a field of 17 kOe is insufficient to rotate magnetic moments out of planes perpendicular to the c-axis but that rotations in these planes occur rapidly for fields above a critical value. A calculation considering interactions between neighbouring and next-nearest neighbouring planes yields a graph of magnetization against field in good agreement with the experimental results of Meyer and Taglang (Abstr. 2409 of 1957). D.M.Edwards

539.2 : 538.2

8064 AN APPROXIMATE METHOD OF CALCULATING THE GROUND STATE OF AN ISOTROPIC ANTIFERROMAGNETIC. Pu Fu-Cho [P'u Fu-Ch'uo].

Dokl. Akad. Nauk SSSR, Vol. 130, No. 6, 1244-7 (1960). In Russian.

The value of the intensity of magnetization of an isotropic antiferromagnetic, holding over all ranges of temperature is calculated. The method is that by which Bogolyubov and Tyablikov (Abstr. 10621 of 1959) calculated the intensity of magnetization of a ferromagnetic. The Hamiltonian of the substance is first written down, expressed in terms of spin operators, and is then transformed into terms of Pauli operators. The Green's functions are introduced. Then, following various operations and the introduction of simplifying assumptions, the intensity of magnetization and the average energy of the substance are obtained in terms of a certain variable h. Numerical values are worked out for two cases in which (1) h is very much less than unity and (2) when $2 - h$ is greater than or approximately equal to zero. When $h \geq 2$, the substance becomes a ferromagnetic. N.Davy

539.2 : 538.2

8065 NEUTRON DIFFRACTION STUDY OF ANTIFERROMAGNETIC SPIN WAVES IN α-FERRIC OXIDE. J.A.Goedkoop and T.Riste.

Nature (London), Vol. 185, 450-2 (Feb. 13, 1960).

From the diffuse peak widths near the (111) Bragg reflection the spin wave velocity and hence an approximate value of the exchange integral, -3.5×10^{-3} eV, was obtained and used to calculate the diffuse scattering cross-section. The temperature variation of the reflection intensity was also measured to show that the peaks are almost of pure spin wave origin. E.P.Wohlfarth

539.2 : 538.2

8066 ON THE ASYMPTOTIC BEHAVIOUR OF THE MAYER CLUSTER SERIES IN THE ANTIFERROMAGNETIC PROBLEM.

H.N.V.Temperley.

Proc. Phys. Soc., Vol. 74, Pt 4, 432-43 (Oct., 1959).

In continuation of the work of a former paper (Abstr. 6992 of 1960), it is shown that the Mayer series for the antiferromagnetic problem can be related in various ways to the placing of links on the lattice. The two such transformations found in the former paper are shown to be special cases of a general theory, which can also be used to relate many other problems of physical interest (e.g. the packing of linear and branched polymers on a lattice, cross-linking, gel formation, etc.) with the Onsager—Ising problem. The Mayer series is analysed into sub-series, the behaviour of some of which can be determined from known results on the "link" problem, while that of others can, in principle, be obtained from the general transformation theory just mentioned. The conclusion of the former paper, that the Mayer z-series has a positive singularity determining the transition but a negative singularity nearer the origin determining its radius of convergence, is confirmed, as are most of the conclusions from the earlier work. The results appear to be reliable in the interesting region near T = 0 but break down as H → 0 on the transition curve is approached.

539.2 : 538.2

8067 EXCHANGE INTERACTIONS IN ANTIFERROMAGNETIC SALTS OF IRIDIUM. I. PARAMAGNETIC RESONANCE EXPERIMENTS.

J.H.E.Griffiths, J.Owen, J.G.Park and M.F.Partridge.

Proc. Roy. Soc. A, Vol. 250, 84-96 (Feb. 24, 1959).

Paramagnetic resonance methods have been used to investigate Ir—Ir exchange interactions in K_2IrCl_6 and $(NH_4)_2IrCl_6$. Measurements are described of the resonance spectrum from nearest-neighbour pairs of Ir ions in semi-dilute mixed crystals where Pt is substituted for Ir. The results show that the isotropic part of the Ir—Ir exchange, J/k is antiferromagnetic and of magnitude 11.5 ± 1°K and 7.5 ± 1°K for the potassium and ammonium salts, respectively. There is also found to be an anisotropic part with rhombic symmetry and with magnitude of order 1 cm^{-1}. No lines attributable to next-nearest-neighbour pairs were found, and it is suggested that this interaction is small. The results are compared briefly with the magnetic susceptibility experiments of Cooke et at. (part II) who find that the concentrated salts go antiferromagnetic in the liquid helium temperature range, and also with the theoretical analysis of the superexchange mechanism given by Judd (part III). See following abstracts.

539.2 : 538 2

8068 EXCHANGE INTERACTIONS IN ANTIFERROMAGNETIC SALTS OF IRIDIUM. II. MAGNETIC SUSCEPTIBILITY MEASUREMENTS.

A.H.Cooke, R.Lazenby, F.R.McKim, J.Owen and W.P.Wolf.

Proc. Roy. Soc. A, Vol. 250, 97-109 (Feb. 24, 1959).

Measurements have been made of the magnetic susceptibilities of ammonium and potassium chloroiridates at temperatures between room temperature and 1°K. The results obtained at high temperatures have been analysed into a susceptibility following a Curie—Weiss law together with temperature-independent terms. The values of the isotropic exchange interactions between neighbouring iridium ions deduced from the Weiss constant agree well with those calculated from paramagnetic resonance measurements. At lower temperatures the magnetic susceptibilities become almost independent of temperature over a certain range and then fall sharply at the antiferromagnetic transition points (2.16°K for the ammonium salt, 3.08°K for the potassium salt). These results are discussed in terms of the exchange interaction between nearest- and next-nearest-neighbour iridium ions.

539.2 : 538.2

8069 EXCHANGE INTERACTIONS IN ANTIFERROMAGNETIC SALTS OF IRIDIUM. III. THEORY OF THE INTERACTION.

B.R.Judd.

Proc. Roy. Soc. A, Vol. 250, 110-20 (Feb. 24, 1959).

A theoretical description is given of the interaction between tw iridium ions, each surrounded by an octahedron of chlorine ions, in a semi-dilute crystal. Group theory is used to classify the states and to examine the various contributions to the Hamiltonian. The lowest energy level of the two iridium-chorine complexes is a quadruplet, which breaks up under the interaction into a singlet and a triplet. The singlet-triplet separation and also the splitting of the triplet are related to various exchange integrals, and it is shown that the arrangement of the energy levels is a consequence of the directional nature of p-orbitals on the chlorine sites.

539.2 : 538.

8070 THEORY OF THE MAGNETIC PROPERTIES OF FERROUS AND COBALTOUS OXIDES.I.

J.Kanamori.

Progr. theor. Phys., Vol. 17, No.2, 177-96 (Feb., 1957).

The magnetic properties of antiferromagnetics, FeO and CoO, are investigated from the standpoint of the one-ion approximation. In their crystalline field of cubic symmetry the orbital degeneracie of Fe^{++} and Co^{++} are not completely removed and the residual orbital angular momenta play an important role through the presence of the spin—orbit coupling and through the direct effect of the orbita magnetic moments. After deriving the effective Hamiltonian for these degenerate cases, which corresponds to the Hamiltonian derived by Pryce (Abstr. 2562 of 1950), for the non-degenerate case, the paramagnetic susceptibility, the Neel temperature and the state of each ion at absolute zero are discussed. A reasonable quantitative interpretation of the susceptibility of CoO in paramagnetic state is given and good agreement is obtained with experiment for the magnetic moment of CoO in antiferromagnetic state. For FeO, sufficiently reliable data to compare with theory are not available at present, but a preliminary comparison is made. Further, in connection with the investigation of the validity of the theory, the origin of the crystalline field are discussed and it is pointed out that the covalent effect may make an appreciable contribution to the crystalline field.

539.2 : 538.2

8071 THEORY OF THE MAGNETIC PROPERTIES OF FERROUS AND COBALTOUS OXIDES.II.

J.Kanamori.

Progr. theor. Phys., Vol. 17, No. 2, 197-222 (Feb., 1957).

The origins of the magnetic anisotropy energies of the crystals of FeO and CoO in the state of antiferromagnetic ordering and the mechanism of the deformation they suffer when the antiferromagneti ordering sets in are investigated from the atomistic point of view, following the line developed in the preceding abstract. It is concluded that the most effective part of the magnetic anisotropy energy in the deformation-free state of the crystals originates from orbital multipole (or van Vleck's orbital valence) interactions arising from both the coulomb and exchange interactions between cations. The deformation of the crystals, however, is caused mainly by magnetostriction arising from linearly strain-dependent terms of the crysta line field energies. It is shown that the theoretical determination o the axis and magnitude of the deformation, using the point charge model for the calculation of the crystalline field, can give results which are semi-quantitatively consistent with the experimental results. It is shown that in CoO the deformation-dependent anisotropy energy overcomes other anisotropy energies and determines the direction of the magnetization to be the direction of the tetragonal axis of deformation, [001], while in FeO the deformation-independent anisotropy energies are predominant in determining that direction, whic coincides with the crystalline trigonal axis, [111]. Discussions are also given for other kinds of deformations which do not depend on th orientation of the magnetic moments, that is, the volume striction and the trigonal deformation suggested by Greenwald and Smart (Abstr. 492 of 1951). A brief comment is given on the magnetic anisotropies of MnO, MnS and NiO.

539.2 : 538.2

8072 ANTIFERROMAGNETISM OF Zn-FERRITE.

M.Tachiki and K.Yosida.

Progr. theor. Phys., Vol. 17, No. 2, 223-40 (Feb., 1957).

Assuming a reasonable magnetic superstructure of tetragonal symmetry, the magnetic anisotropy of Zn ferrite is discussed. Mag netic moment carriers are Fe^{3+} ions in this substance. Therefore, the main source of the anisotropy energy is considered to be the magnetic dipole—dipole interaction between spins of Fe^{3+} ions, whic gives the anisotropy energy depending upon the crystallographic orientation of the common axis of + and - spins below the Neel temperature, whereas above this temperature it does not give any aniso tropy on account of the cubic structure of this crystal. The calculated anisotropy energy below the Neel temperature takes a minimu value when the direction of the magnetic moment lies in the plane perpendicular to the tetragonal c-axis. If the anisotropy in this plane is sufficiently small, the powder susceptibility would remain constant below the Neel temperature. This is supported by the experimental result. Further, the short range order is introduced by a method somewhat like that used by Li (Abstr. 1943 of 1952). The behaviours of the susceptibility and the specific heat near the Neel temperature are investigated by this method. The effect of the short range order on the susceptibility is shown to be considerable, but the constancy of the perpendicular susceptibility with respect to temperature is expected to remain almost unchanged.

539.2 : 538.2

8073 SHIFT OF THE CURIE TEMPERATURE DURING UNIFORM COMPRESSION OF MANGANESE AND COBALT FLUORIDES. D.N.Astrov, S.I.Novikova and M.P.Orlova.

Zh. eksper. teor. Fiz., Vol. 37, No. 5 (11), 1197-201 (Nov., 1959).
In Russian.

Shift of the Curie temperature due to uniform compression was determined for the antiferromagnetic substances MnF_2 and CoF_2. The shifts are derived from measurement of the magnetic susceptibility and variation of the linear expansion coefficients of polycrystalline samples at the transition temperature. At a pressure of (1900 ± 100) atm the shift for MnF_2 was found to be $(1.5 \pm 0.2)^\circ$. No shift was detected in CoF_2. The antiferromagnetic transformation temperatures are respectively 68° K and 39° K.

539.2 : 538.2

8074 ANOMALOUS TEMPERATURE DEPENDENCE OF THE MAGNETIC PROPERTIES OF ALLOYED PERMALLOY AND THE INFLUENCE OF ORDERING ON ITS MAGNETIC TRANSITION. M.V.Dekhtyar and N.M.Kazantseva.

Fiz. Metallov i Metallovedenie, Vol. 7, No. 3, 453-5 (1959).
In Russian.

Supermalloy was quenched from 1200° C. Heating at 300° C led to the appearance of short-range order. Continued heating gave two magnetic transitions: the first at 375° C corresponded to loss of ferromagnetic properties; the second at 448° C marked the transition to the paramagnetic state. Measurement of magnetic moment, coercive force and susceptibility in the temperature range 375 to 448° C lead to the conclusion that the 375° C transition is related to the appearance of antiferromagnetic orientations of the magnetic moments. A.F.Brown

Magnetic Resonances

539.2 : 538.27

8075 FERROMAGNETIC RESONANCE AND THE THEORY OF PHASES. A.Coumes.

C.R. Acad. Sci. (Paris), Vol. 250, No. 5, 819-21 (Feb. 1, 1960).
In French.

The ferromagnetic resonance line obtained with a single crystal plate of Fe–Si is explained in terms of the theory of phases due to Neel [J. Phys. Rad., Vol. 5, 241 (1944)]. D.J.Oliver

539.2 : 538.27

8076 INFLUENCE OF THE POROSITY ON THE WIDTH OF THE ABSORPTION CURVE OF YTTRIUM GARNET PURE AND SUBSTITUTED WITH Cr AND Al. R.Vautier and A.J.Berteaud.

C.R.Acad. Sci. (Paris), Vol. 250, No. 10, 1812-14 (March 7, 1960).
In French.

As the porosity of the specimen is reduced, the width ΔH of the resonance curve decreases. With relatively constant porosity, substitution of Fe by Al decreases ΔH, whereas ΔH increases with increasing Cr content. R.C.Kell

539.2 : 538.27

8077 ON THE THEORY OF FERROMAGNETIC RESONANCE. S.V.Tyablikov.

Fiz. tverdogo Tela, Vol. 2, No. 2, 361-8 (Feb., 1960).

Using the results of a previous work (Abstr. 10621 of 1959), formulae are deduced for the frequency of ferromagnetic resonance and for the susceptibility by applying the method of two-time temperature Green's functions. P.Roman

539.2 : 538.27

8078 INTERNAL FERROMAGNETIC RESONANCE IN SMALL COBALT PARTICLES. J.C.Anderson.

Proc. Phys. Soc., Vol. 75, Pt 1, 33-9 (Jan., 1960).

Experiments are described in which small particles of cubic cobalt have been obtained by precipitation from a 2% Co–Cu alloy for the purpose of measuring the total internal magneto-crystalline anisotropy field as a function of particle radius. Two methods have been used, namely static torque measurements of the principal anisotropy constants and dynamic measurements based on spin resonance in the anisotropy field. The two methods yield fair agreement in the values calculated for the anisotropy field in a range of particle sizes. The field is found to vary little with particle radius in a single-crystal specimen and this is interpreted as evidence that internal resonance is independent of shape anisotropy.

539.2 : 538.27

8079 SPIN TEMPERATURE AND HIGH POWER EFFECTS IN FERRIMAGNETS. M.T.Weiss.

J. appl. Phys., Vol. 30, No. 12, 2014 (Dec., 1959).

Distortion and hysteresis in the form of ferromagnetic resonance curves have been observed in manganese ferrite spheres at high microwave powers. These effects are attributed to g factor changes arising from an increase in spin temperature by the mechanism proposed by Suhl [J. Phys. Chem. Solids, Vol. 1, 209-27 (1957)] A.J.Manuel

539.2 : 538.27

8080 HIGH POWER EFFECTS IN FERRIMAGNETIC RESONANCE. P.E.Seiden and H.J.Shaw.

J. appl. Phys., Vol. 31, No. 2, 432-3 (Feb., 1960).

During ferrimagnetic resonance experiments at high power levels in yttrium iron garnet (YIG) small, sharp discontinuities in susceptibility, superimposed upon the continuous decline with increased power seen by earlier workers, have been noted. As many as nine discountinuities have been seen in one sample The size of the discountinuity, and the numbers are roughly inversely proportional to the sample line width. The occurance follows the empirical relation $h^2 = k \exp(^{n}/_{c})$, where n is the number of the discontinuity, in order of occurance; k and c are constants. For most samples having a large number of discontinuities, c lies between 1.2 and 3.2. Two other associated effects have also been noted. One is a similar effect when the r.f. power level is set at a value above the first discontinuity and the frequency varied. The other is the occurance of a region of instability just after the first discontinuity. S.A.Ahern

539.2 : 538.27

8081 HIGH–POWER EFFECTS ON FERRIMAGNETIC RESONANCE. M.T.Weiss.

J. appl. Phys., Vol. 31, No. 5, 778-82 (May, 1960).

Ferrimagnetic resonance experiments have been performed on single-crystal spheres of manganese ferrite at high microwave power levels. The variation of susceptibility with power level is in good agreement with Suhl's recent theoretical treatment (Abstr. 1819 of 1960) of the saturation process in which scattering of the uniform precession into spin waves caused by impurities and imperfections is taken into account. Results show that the ratio of intrinsic to scattering decay constants is close to zero, so that the susceptibility decreases gradually at power levels substantially below the theoretical critical signal level. At very high power levels, various anomalous effects appear such as absorption line asymmetries, bistabilities, and flat-topped absorption lines.

539.2 : 538.27

8082 CORRELATION TIMES, LINE WIDTHS, AND CROSS RELAXATION OF SPIN SYSTEMS IN SOLIDS.

J.I.Kaplan.
Amer. J. Phys., Vol. 28, No. 5, 491-4 (May, 1960).

A simple computational formulation is derived for calculating line widths of electron (or nuclear) spin resonance absorption in solids. The method is not limited to a Zeeman local field energy. It is further shown how, starting with time-dependent perturbation theory, cross-relaxation times are calculated. In both cases the results are expressed as the Fourier transform of a correlation function.

539.2 : 538.27

8083 ELECTRON SPIN RESONANCE OF COLLOIDAL SODIUM IN SODIUM AZIDE.

G.J.King, B.S.Miller, F.F.Carlson and R.C.McMillan.
J. chem. Phys., Vol. 32, No. 3, 940 (March, 1960).

Sodium azide, partially decomposed by irradiation with mercury light while hot, shows a strong Lorentzian line which is attributed to metallic sodium. E.F.W.Seymour

539.2 : 538.27

8084 PARAMAGNETIC RESONANCE IN MAGNETICALLY DILUTE SYSTEMS. N.S.Garif'yanov.

Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1551-7 (Dec., 1959). In Russian.

Dependence of the ratio b/c of the magnetic specific heat (b) and the Curie (c) constants on the degree of dipole--dipole magnetic interactions in crystals and solutions containing Cr^{+++}, Fe^{+++}, Mn^{++}, Cu^{++} and VO^{++} was investigated by the paramagnetic resonance method in parallel fields in the frequency range from 300 to 1.6 Mc/s at T = 90° K.

539.2 : 538.27

8085 PARAMAGNETIC RESONANCE AND PARAMAGNETIC RELAXATION IN SOLUTIONS OF IRON-GROUP SALTS.

V.I.Avvakumov, N.S.Garif'yanov, B.M.Kozyrev and P.G.Tishkov.
Zh. eksper. teor. Fiz., Vol. 37, No. 6(12), 1564-9 (Dec., 1959).
In Russian.

Results of experiments on paramagnetic resonance and paramagnetic relaxation in liquid solutions of salts of the iron group are compared with existing theories.

539 2 : 538 27

8086 INVESTIGATION OF THE ELECTRON PARAMAGNETIC RESONANCE SPECTRUM OF V^{3+} IN CORUNDUM.

G.M.Zverev and A.M.Prokhorov.
Zh. eksper. teor. Fiz., Vol. 38, No. 2, 449-54 (Feb., 1960).
In Russian.

Electron paramagnetic resonance in a corundum single crystal containing 0.13% V^{3+} was investigated. The experimental results are interpreted with the aid of a spin Hamiltonian. The constants of the spin Hamiltonian were determined: $g_{\parallel} = 1.915 \pm 0.002$; $D = (+7.0 \pm 0.3)\ cm^{-1}$; $|A| = (0.959 \pm 0.005) \times 10^{-2}\ cm^{-1}$; $|E| < 10^{-2}\ cm^{-1}$.

539.2 : 538.27

8087 THE SHAPE AND TEMPERATURE DEPENDENCE OF ELECTRON SPIN RESONANCE LINES OF LOCAL ELECTRON CENTRES IN CRYSTALS. M.F.Deigen and A.B.Roitsin.

Zh. eksper. teor. Fiz., Vol. 38, No. 2, 489-98 (Feb., 1960).
In Russian.

The hyperfine structure is calculated and the electron spin resonance of local electron centres in crystals is considered with allowance for oscillations of the ions (atoms). The shape of the electron paramagnetic line and its temperature dependence are determined. The line shape was found to be of the Lorentz type. As an example e.s.r. of F-centres in NaCl type crystals is considered. The theoretical results agree with the experiments. From the half-width of the e.s.r. line one can compute the spin–lattice relaxation time. Numerical estimates of this relaxation time for F-centres yield satisfactory agreement between theory and experiment.

539.2 : 538.27

8088 SATELLITE LINES IN THE PARAMAGNETIC RESONANCE SPECTRA OF IMPURITIES IN CALCIUM FLUORIDE. J.M.Baker, W.Hayes and M.C.M.O'Brien.

Proc. Roy. Soc. A, Vol. 254, 273-90 (Feb. 9, 1960).

In the electron spin resonance spectra of some lanthanon impurities in CaF_2 the lines are flanked by satellites which are due to transitions in which a neighbouring fluorine nucleus flips with the electron. The theory of these transitions is discussed and applied to the analysis of the satellite structure in the spectrum of Ce^{3+} in CaF_2. It appears that the coupling between the electron and the fluorine ion includes some s-contact character. There is evidence for the presence of a neighbouring interstitial fluorine ion to compensate for the extra positive charge on the Ce^{3+} ion.

539.2 : 538.27

8089 A NUCLEAR MAGNETIC RESONANCE STUDY OF COLEMANITE. F.Holuj and H.E.Petch.

Canad. J. Phys. Vol. 38, No. 4, 515-46 (April, 1960).

A single crystal of colemanite, $CaB_3O_4(OH)_3.H_2O$, which is known to be ferroelectric at temperatures below about –2° C, has been investigated by means of nuclear magnetic resonance (n.m.r.) techniques. The B^{11} resonances are split because the nuclear Zeeman levels are perturbed by the interactions between the nuclear electric quadrupole moments and the electric field gradients existing at the boron sites. The splittings have been examined in detail at room temperature and at –40° C. The results have been analysed and the quadrupole coupling constants, the asymmetry parameters, and the orientations of the principal axes of the electric field gradient tensors existing at the boron sites at room temperature and –40° C are reported. Selected B^{11} resonance lines have been examined over the temperature range 40° C to –120° C with particular emphasis on the region about 0° C where a phase transition occurs. The complex proton signal was also studied over the same temperature range. Abrupt broadening of this signal occurred at the phase transition. These studies revealed that the crystal may transform from its centrosymmetrical room-temperature (point group 2/m) form either to a metastable monoclinic form with point group 2 or to a triclinic form with point group 1. It is not clear whether two trans tions, separated by only about 3° C, are involved or whether there is only one transition with two alternative arrangements, differing onl slightly in activation energy, available to the structure. The transi tion or transitions are of the second-order displacive type. Where possible, the results have been interpreted in terms of the crystal structure.

539.2 : 538.2

8090 SPIN TEMPERATURE AND NUCLEAR POLARIZATION A.Abragam.

Physica, Vol. 24, Supplement, S79 (Sept., 1958).

Low Temperature Physics Conference (see Abstr. 7017 of 196 Brief note only, for reference to complete text see Abstr. 2523 (195

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8091 NUCLEAR MAGNETIC RELAXATION IN SOLID HYDROGEN. T.Moriya and K.Motizuki.

Progr. theor. Phys., Vol. 18, No. 2, 183-99 (Aug., 1957).

A theoretical study of the mechanisms of the relaxation in soli H_2 and solid D_2 related with their nuclear magnetic resonances is given. When the self-diffusion of the molecules is not significant, the predominant nuclear relaxation mechanism is considered to result from the intramolecular interaction modulated by the intermolecular interaction which makes the orientations of the molecules change from time to time. The formula for T_1 due to this mechanis is given and the actual calculations are carried out for solid H_2 and solid D_2 at temperatures well above the transition point. The result for H_2 agrees with Bloom's (> 11° K) (Abstr. 3462 of 1958) and Hatton–Rollin's (4.2 ~ 10° K) experimental values (Abstr. 427 of 1950). The effect of self-diffusion on T_1 is treated both for H_2 and D_2 using the B.P.P. theory and the values of the self-diffusion time estimated from Bloom's data for T_2. This effect is small under Bloom's experimental condition (30 Mc/s, while it is important in Hatton–Rollin's case (5.4 Mc/s). This agrees with their experimental results though for the latter case the theoretical temperatur dependence of T_2 is stronger than the experimental one. Discussion is also given on the case where the self-diffusion becomes very rapid and it modulates appreciably the intermolecular forces dependent on the orientation of the molecules. Bloom's experiment in the liquid state seems to be explained by this mechanism. The role of the spin-spin relaxation in establishing the thermal equilibrium within the whole spin system is discussed. This effect will be especially important for solid D_2.

539.2 : 538.2

8092 ELECTRON NUCLEAR DOUBLE RESONANCE EXPERIMENTS WITH RUBY.

R.W.Terhune, J.Lambe, G.Makhov and L.G.Cross.
Phys. Rev. Letters, Vol. 4, No. 5, 234-6 (March 1, 1960).

When the $(\frac{1}{2} \rightleftharpoons -\frac{1}{2})$ electron spin resonance of Cr^{3+} ions in ruby (Al_2O_3 0.05% Cr^{3+}) was observed using a high microwave power, a marked decrease in the absorption occurred if the specimen was subjected to radiofrequency waves at any of the frequencies corresponding to the Al^{27} nuclear resonance or to hyperfine transitions of the Cr^{53} ions. The mechanism of the effect is not clear.

E.F.W.Seymou

539.2 : 538.2

8093 THE PROTON MAGNETIC RESONANCE ABSORPTION OF THE TRICHLOROACETIC ACID IN SOLID PHASE.

M.Yagi and M.Ueta.
J. Phys. Soc. Japan, Vol. 14, No. 3, 377 (March, 1959).

A nuclear magnetic resonance absorption study of trichloroacetic acid has been made. From the observed spectrum it is concluded that the acid takes the form of a dimer in the solid state. The value obtained for the H–H distance is 2.46 ± 0.03 A.

S.A.Aher

539.2 : 538.2

8094 ZEEMAN STUDY OF NUCLEAR QUADRUPOLE RESON ANCE SPECTRUM IN p-DIBROMOBENZENE.

K.Shimomura.

J. Phys. Soc. Japan, Vol. 14, No. 2, 235-6 (Feb., 1959).

The Zeeman analysis of the bromine quadrupole resonance spectrum in p-dibromobenzene was performed. There are two non-equivalent directions of the z-axis of the field gradient tensor. The asymmetry parameter of this field gradient tensor $\eta = 0.05 \pm 0.01$ is less than half the value found by Kojima et al. (Abstr. 8129 of 1955).

J.M.Baker

539.2 : 538.56

8095 A NEW CLASS OF MATERIALS FOR BLOEMBERGEN-TYPE MASERS. B.Bleaney.

Proc. Phys. Soc., Vol. 73, Pt 6, 937-9 (June, 1959).

The purpose of the note is to point out that there is a class of substances where there are four levels degenerate in zero field, which have a linear Zeeman effect, but are not necessarily equally spaced when a magnetic field is applied, and where there are allowed transitions which are not limited to those between adjacent energy levels. This is the situation for any state designated by Γ_8 in Bethe's notation. The Ce^{+++} ion ($4f^1$, $^2F_{5/2}$) in a cubic crystal field is discussed as an illustration.

J.M.Baker

539.2 : 538.56

8096 THE SPIN HAMILTONIAN OF A Γ_8 QUARTET. B.Bleaney.

Proc. Phys. Soc., Vol. 73, Pt 6, 939-42 (June, 1959).

The effects described in the previous abstract cannot be represented by a spin Hamiltonian of the normal kind, though it would be useful to find a spin Hamiltonian to represent this situation, using an effective spin S - 3/2 as there are four levels. The spin Hamiltonian $\mathcal{H} = g\beta(H_xS_x + H_yS_y + H_zS_z) + f\beta(H_xS_x^3 + H_yS_y^3 + H_zS_z^3)$ is found to be suitable with two possible ways of assigning the four values of S_z to the states. Although the two ways are exactly equivalent, the values of g and f for the two cases are different.

J.M.Baker

MECHANICAL PROPERTIES OF SOLIDS

539.3

8097 ELECTRO-DYNAMIC EXTENSOMETER WITH ELECTRICAL REGISTRATION. F.X.Eder and U.Däunert.

Exper. Tech. der Phys., Vol. 7, No. 5, 225-7 (1959). In German.

This paper describes an extensometer for tensile breakdown testing in which a metal wire of about a millimetre in diameter and about 20 mm long is subjected to an extremely rapid extension by means of a magnetic solenoid system. The tension is measured by a quartz crystal and the extension by means of an electrical differential capacity micrometer; the stress—strain curve is displayed on a cathode ray tube provided with a time marker.

T.Mulvey

539.3

8098 APPARATUS FOR THE MEASUREMENT OF THE MECHANICAL PROPERTIES OF FIBRES. F.R.Morgan.

J. sci. Instrum., Vol. 37, No. 1, 25-7 (Jan., 1960).

Apparatus for determining the mechanical properties of eight fibres simultaneously is described. The apparatus provides for tests to be made at different relative humidities, chainomatic loading up to about 450 g, and measurement of extensions of the order of 10^{-3} cm.

539.3

8099 APPARATUS FOR THE MEASUREMENT OF YOUNG'S MODULUS, BETWEEN −200 AND 700°C BY TRANSVERSE VIBRATION IN VACUUM. H.J.Stokes.

J. sci. Instrum., Vol. 37, No. 4, 117-20 (April, 1960).

The construction and use of apparatus for the determination of Young's Modulus by means of transverse vibrations of specimens in strip form four inches long are described. Two vacuum chambers are employed, one for immersion in liquid nitrogen and the other incorporating a small furnace for operation at temperatures up to 700°C, the electronic units being common to both. Typical results are included to illustrate use of the equipment, the accuracy of which is claimed to be within ±1% for absolute values.

539.3

8100 PRODUCTION AND TENSILE TESTING OF STRAIN-FREE METAL SPECIMENS. G.Greetham and A.J.Martin.

J. sci. Instrum., Vol. 37, No. 5, 160-2 (May, 1960).

Details are given of equipment which has been used to prepare and mechanically test single crystal specimens of beryllium from a zone refined rod. An electrolytic etching machine is described whereby the test-pieces may be prepared without mechanical deformation, and details are given of a modified Polanyi apparatus in which specimens may be tested in tension at temperatures up to about 600°C.

539.3 : 621.317.79

8101 MEASUREMENT OF CYCLIC STRAIN. T.M.Dowell and J.A.Mackinnon.

J. sci. Instrum., Vol. 37, No. 4, 138-40 (April, 1960).

A versatile multi-way instrument for measuring periodic strain-gauge signals is described. The strain is either shown on a meter or can be accurately measured on an oscilloscope in terms of resistance change. Full-scale deflection of the meter is obtained for strains in the order of $\pm 10^{-4}$.

539.3

8102 DEPENDENCE OF BENDING OF A STRIP ON POSITION OF EDGE DISLOCATIONS. F.Kroupa.

Czech. J. Phys., Vol. 9, No. 4, 488-94 (1959). In German.

Classical elasticity theory is used to determine the stress distribution in an infinite strip containing an edge dislocation perpendicular to its plane and with the Burgers' vector parallel to the axis of the strip. Expressions are also derived for curvature of the strip as a function of position of the dislocation and for the curvature due to a general distribution of dislocations regarded as a continuum.

J.W.Leech

539.3

8103 EFFECT OF FAST NEUTRON BOMBARDMENT AT VARIOUS TEMPERATURES UPON THE YOUNG'S MODULUS AND INTERNAL FRICTION OF COPPER.

D.O.Thompson and V.K.Paré.

J. appl. Phys., Vol. 31, No. 3, 528-35 (March, 1960).

Studies have been made of the variations of internal friction and elastic modulus irradiation of pure copper crystals at a number of temperatures in the range 90° K to 300° K. The results are interpreted in terms of pinning of dislocation lines by radiation defects migrating from their points of origin. In terms of the room temperature value the dislocation pinning rate is 2.5×10^{-2} in the range 100° K to 140° K and (from previous measurements) of the order of 2.5×10^{-5} at 20° K. On slowly warming the sample after the irradiation, it is found that at 260° K the modulus and decrement begin to move rapidly toward their "saturation" values. Presumably defects "stored" in the sample due to a lack of thermal mobility at the irradiation temperature become mobile at this temperature and move to the dislocation lines.

539.3

8104 ELASTIC CONSTANTS OF YTTRIUM SINGLE CRYSTALS IN THE TEMPERATURE RANGE 4.2-400° K.

J.F.Smith and J.A.Gjevre.

J. appl. Phys., Vol. 31, No. 4, 645-7 (April, 1960).

The five independent elastic constants for yttrium single crystals have been determined by the pulse-echo technique over the temperature range 4.2-400° K. The experimental values extrapolated to 0° K are: $C_{11} = 8.34 \pm 0.02$, $C_{33} = 8.01 \pm 0.02$, $C_{44} = 2.690 \pm 0.006$, $C_{12} = 2.91 \pm 0.03$, and $C_{13} = 1.9 \pm 0.4$ in units of 10^{11} d/cm². The degree of elastic anisotropy is low throughout the entire temperature range. The curves illustrating the temperature dependence of the elastic constants show several inflections, and the curve for C_{11} crosses that for C_{33} near 390° K. The behaviour is somewhat unusual, and is probably explicable on the basis that the degree of band overlap in yttrium is quite sensitive to interatomic spacing. Such a sensitivity has previously been postulated to explain the temperature dependence of the Hall coefficient.

539.3 : 539.219

8105 YOUNG'S MODULUS OF ZIRCONIUM—NIOBIUM ALLOYS. Yu.F.Bichkov, A.N.Rozanov and D.M.Skorov.

J. nuclear Energy, Vol. 5, No. 3-4, 408-12 (1957). English translation of article in Atomnaya Energiya, Vol. 2, 152 (1957).

The results are given of measurements of the value of Young's modulus for zirconium—niobium alloys in vacuum at temperatures up to 950° C, and also at room temperature after various heat treatments.

539.3

8106 THE EFFECT OF ANNEALING ON YOUNG'S MODULUS OF THE SINGLE CRYSTAL PLATE OF ALUMINIUM. T.Yamashita.

J. Sci Hiroshima Univ. A, Vol. 18, No. 2, 221-6 (Dec., 1954).

The three different kinds of the single crystal plates of aluminium, which have the special crystallographic orientations, [100] (100), [111] (1$\bar{1}$0) or [110] (110), were submitted to various annealings and Young's moduli were measured at 15°C. It is found that Young's modulus varies on annealing in the range 200-365°C, and that the aspect of its variation is remarkably different according to the crystallographic orientation. By measuring the electric resistance of specimens of the same kind, it is suggested that the variation of Young's modulus on annealing would be due mainly to the variation of the quantity of the free silicon in the body crystal of aluminium.

539.3 : 531.25

PLANE STRAIN COMPRESSION BETWEEN ROUGH INCLINED PLATES. See Abstr. 6714

539.3 : 531.25

PLASTIC COMPRESSION OF THIN MATERIAL BETWEEN SMOOTH PLATES UNDER CONDITIONS OF PLANE STRAIN. See Abstr. 6713

539.3

8107 ON THE PLASTIC DEFORMATION OF THE SINGLE CRYSTAL PLATES OF ALUMINIUM. T.Yamashita.
J. Sci. Hiroshima Univ. A, Vol. 18, No. 2, 227-36 (Dec., 1954).

The behaviour of single crystal plates having special crystallographic orientations was investigated by extending the plates to their lengthwise direction, ranging from elongation just beyond the elastic limit to 1%. The following results were obtained: The behaviour of the elongation of a single crystal plate is different according to the orientation, and, of course, according to the crystallographic plane parallel to the surface of the plate, despite its having the same crystallographic axis in the lengthwise direction of the plate. At the early stage of the elongation, the greater the number of active slip planes, the more easily the shear strain occurs, whereas for larger elongation, the shear strain is more difficult to establish with an increasing number of active slip planes. In the latter region of elongation, multiple slip occurs more frequently with an increasing number of active slip planes, leading to a more pronounced work hardening.

539.3

8108 STRAIN AMPLITUDE DEPENDENCE OF THE DYNAMICAL PROPERTIES OF RUBBERS. N.M.Borovitskaya.
Zh. tekh. Fiz., Vol. 28, No. 12, 2689-92 (Dec., 1958). In Russian.
English translation in: Soviet Physics—Technical Physics (New York), Vol. 3, No. 12, 2458-60 (Dec., 1958).

The investigations were carried out by a modulation-interference method in the range of strain amplitudes from 0.01 to 0.75% at a frequency of 100 c/s and at a constant temperature of 18°C. The dynamic modulus of filled rubbers at first increases with decreasing strain amplitude, but at a certain value of the amplitude, remains practically constant. The phase difference between the force acting on the rubber and the strain decreases with decreasing strain amplitude. In unfilled rubbers, the dynamic modulus and phase difference were independent of the strain amplitude over the above range.

539.3 : 535 : 539.2

8109 MEASUREMENT OF THE MECHANICAL AND PHOTO-ELASTIC CHARACTERISTICS OF A PLASTIC MATERIAL SUBMITTED TO SINUSOIDAL FORCES AT LOW FREQUENCY (LESS THAN 50 c/s). A.Lagarde and R.Jacquesson.
C.R. Acad. Sci. (Paris), Vol. 250, No. 6, 969-71 (Feb. 8, 1960).
In French.

The experimental method is briefly described. Araldite is used. The coefficient of dynamic rigidity is given as 340 ± 20 kg mm^{-2} and the method of finding the photoelastic constant discussed.

H.G.Jerrard

539.3 : 532.1

8110 DYNAMIC MECHANICAL PROPERTIES OF POLYETHYLENE FROM 25° TO 150°C.
E.R.Fitzgerald and M.T.Watson.
J. Acoust. Soc. Amer., Vol. 32, No. 5, 584-93 (May, 1960).

Measurements of the complex shear compliance ($J^* = J' - iJ''$) were carried out for three polyethylene samples of increasing weight average to number average molecular weight ratios ($\bar{M}_w/\bar{M}_n$) of 19, 70, and 110. The measurements extended to temperatures well above the crystalline melting points of the polyethylenes and over a frequency range from 25 to 2500 c/s. A sudden increase in compliance occurred at all frequencies at the melting points of each type of polyethylene; there were no marked differences in dynamic mechanical behaviour below the melting points. Above the melting points valu of storage compliance (J') were very nearly the same for all the polyethylenes but differences in the loss compliance (J'') were foun In particular at higher frequencies (1300 c/s) values of J'' diverge with temperature in ascending order as $\bar{M}_w/\bar{M}_n$ increased. Values of mechanical loss tangent (J''/J') showed sudden jumps at the mel points but there was no evidence of maxima or peaks at these temperatures. Attempts to superpose the data in the melt were unsuccessful as values of J'' at various temperatures could not be shifted into coincidence even though values of J' superposed fairly well. The superposition anomalies are tentatively ascribed to the presence of a secondary maximum in the loss compliance vs frequency characteristics of the materials while the secondary maximum, in turn, is attributed to either (1) a split molecular weig distribution with two separate maxima, or (2) a β mechanism involving the motion of very long branches.

539.3 : 537.3 : 539

ELECTRICAL EFFECTS DURING CYCLIC STRESSING OF SODIUM CHLORIDE. See Abstr. 7917

539

8111 RECOVERY OF INTERNAL FRICTION IN ALUMINIUM AFTER PLASTIC DEFORMATION. I.Holwech.
J. appl. Phys., Vol. 31, No. 5, 928-31 (May, 1960).

The internal friction in polycrystalline, super purity aluminum has been measured during and after creep under constant load by th ultrasonic pulse method. The increase of internal friction was found to be independent of frequency in the measured range (2.5 to 12 Mc/s). The room temperature recovery of internal friction afte unloading could be described by the formula: $\Delta\alpha = C_1/(t + C_2)^{C_3}$. Typical values of the constants C_2 and C_3 are 10 sec and 0.6, respectively. The experimental results are discussed in terms of the Weertman—Salkovitz (1955) theory of low-amplitude internal friction.

539.

8112 INTERPRETATION OF ELASTO-PLASTIC PHENOMEN BY MEANS OF A LINEAR HEREDITARY THEORY.
G.Colonnetti.
R.C. Accad. Naz. Lincei, Vol. 27, No. 1-2, 14-19 (July-Aug., 1959).
In Italian.

The elastic and plastic deformations $\epsilon(t)$ and $\bar{\epsilon}(t)$ are supposed such that $\bar{\epsilon} = \int_0^t (\epsilon + \bar{\epsilon}) f(t) dt$, and the coefficient of heredity f(t) is expanded in powers of $(\epsilon + \bar{\epsilon})$. The variation of ϵ with distance y from the neutral axis is discussed for the case $(\epsilon + \bar{\epsilon}) \propto yt$.

R.A.Newing

539.

8113 ON THE FOUNDATIONS OF LINEAR ISOTROPIC VISCO ELASTICITY. D.R.Bland.
Proc. Roy. Soc. A, Vol. 250, 524-49 (April 7, 1959).

The properties of a linear viscoelastic material are developed from the hypothesis that the microscopic structure of such a mater is mechanically equivalent to a network of elastic and viscous elements. The stored energy and the rate of dissipation of energy can be found for any material element at any time. For an isotropic material, each deviatoric component of strain is related solely to the corresponding deviatoric component of stress and the dilatation part of the strain solely to the dilatational part of the stress; the energies are the sum of the respective energies for the deviatoric components and for the dilatation. It is shown both that the strain c be expressed in terms of the stress increments and the creep funct The complex compliances and moduli have alternating zeros and poles on the positive imaginary axis and no zeros or poles elsewhe The stress—strain law can be expressed in operational form, $P\sigma = Q\epsilon$, where P and Q are polynomials in d/dt with constant coefficients. The zeros of P and Q are all real and non-positive and they alternate. The energies can be expressed in terms of either the creep function and the stress at previous times, or the relaxati function and the strain at previous times, or the stress, strain and their time derivatives at a given time or, for a sinusoidal oscillati in terms of the complex compliance and its derivative with respect to frequency. It is shown that models consisting of Voigt elements series, or of Maxwell elements in parallel, can represent the mechanical properties and the stored and dissipated energies of an viscoelastic material. The analysis can be extended to networks containing an infinite number of elements. Two examples, one of each of two different cases, are given.

539.3

8114 INHOMOGENEITY OF PLASTIC DEFORMATION IN TENSION. B.M.Strunin.

Dokl. Akad. Nauk SSSR, Vol. 130, No. 2, 310-13 (Jan. 11, 1960). In Russian.

By regarding the microinhomogeneities of plastic deformation as chance quantities, the formula $\sigma^2(1_0,\epsilon) = \text{const}/1_0$ is derived, where $\sigma^2(1_0,\epsilon)$ is the mean square deviation of the strain ϵ; and 1_0 is the length over which the strain is measured. This relation is verified for an alloy containing 92.6% Al, 6.3% Mg and small quantities of Mn, Fe Si and Ti, tested in tension to give mean strains of 2.3%, 8.4% and 12.0%. R.F.S.Hearmon

539.3

8115 LINEARIZED EQUATIONS FOR THREE-DIMENSIONAL PROBLEMS OF IDEALIZED PLASTICITY THEORY.

D.D.Ivlev.

Dokl. Akad. Nauk SSSR, Vol. 130, No. 6, 1232-6 (Feb. 21, 1960). In Russian.

The author applies the first-order, linearized theory to a square beam of slowly varying cross-section. The plastic deformation is caused by a force applied along the axis of the beam. The stress and strain potential functions satisfy a wave equation with appropriate boundary conditions. J.K.Skwirzynski

539.3

8116 EFFECT OF TEMPERATURE AND MOISTURE CONTENT ON THE ORIENTATION PRODUCED BY THE DRAWING OF NYLON 66. C.G.Cannon and F.P.Chappel.

Brit. J. appl. Phys., Vol. 10, No. 2, 68-71 (Feb., 1959).

Increase in moisture content or ambient temperature up to about 165°C, increases the maximum extension obtained by drawing nylon 66 filaments and the resulting orientation of the molecules due to their increased mobility. Above 160°C disorientation due to thermal energy offsets this, and lower birefringences were observed for a given extension. The results are consistent with adiabatic drawing at a neck up to a natural draw ratio determined by the ambient temperature, combined with isothermal drawing uniform along the length of the specimen.

539.3

8117 MECHANISM OF DEFORMATION IN SOLID AMORPHOUS POLYMETHYLMETHACRYLATE AND POLYVINYLACETATE ON COLD DRAWING. G.A.Lebedev and E.V.Kuvshinskii.

Fiz. tverdogo Tela, Vol. 2, No. 1, 96-105 (Jan., 1960). In Russian.

Stress-extension curves at different temperatures and extension velocities are given for the two plastics. Analysis of the curves in terms of the Maxwell theory enables the instantaneous modulus and the stress relaxation velocity to be obtained. R.F.S.Hearmon

539.3

8118 LOW-TEMPERATURE PLASTIC RUPTURE OF COARSE-GRAINED IRON.

I.A.Gindin and Ya.D.Starodubov.

Fiz. tverdogo Tela, Vol. 1, No. 12, 1794-800 (Dec., 1959). In Russian.

The nature of plastic deformation is investigated for high-purity, coarse-grained iron in tension at 4.2, 20 and 77°K. Observations are reported on the formation of cracks and twin layers. Mechanical twinning does not in itself induce cold brittleness in iron. Both inter- and intra-crystalline slip occur at low temperatures and relatively high deformation velocities (0.03 mm/sec). R.F.S.Hearmon

539.3

8119 FLOW OF MAGNESIUM OXIDE SINGLE CRYSTALS. D.S.Thompson and J.P.Roberts.

J. appl. Phys., Vol. 31, No. 3, 433-4 (Feb., 1960).

The effect of temperature on the plasticity and the yield stress of these crystals (99.8% MgO) is described. The stress—strain curves show no sharp yield point and there is no correlation between impurity content and yield stress. The variation of yield stress with temperature is better explained in terms of substructure than simple impurity locking. W.Bardsley

539.3

8120 CREEP OF Al_2O_3 SINGLE CRYSTALS. R.Chang.

J. appl. Phys., Vol. 31, No. 3, 484-7 (March, 1960).

The steady-state creep of Al_2O_3 single crystals was investigated. The experimental data are analysed according to three mechanisms: the dislocation climb mechanism, the micro-creep mechanism, and the Peierls stress mechanism. It is shown that the dislocation climb mechanism fits experimental data best. The expectation that Peierls stress mechanism is rate controlling in the "steady-state" creep of Al_2O_3 is ungrounded.

539.3

8121 THE FLOW OF POLYCRYSTALLINE METALS UNDER SIMPLE SHEAR. II.

E.N. da C. Andrade and K.H.Jolliffe.

Proc. Roy. Soc. A, Vol. 254, 291-316 (Feb. 23, 1960).

For Pt I, see Abstr. 6096 (1952). The flow of lead of different purities under conditions of simple shear was investigated over a wide range of strain, at different stresses, and mostly at a temperature in the neighbourhood of 27°C. The phenomena were studied both with unchanged direction of stress and with the direction of stress reversed during flow. At the beginning of forward creep the $t^{1/3}$ law is strictly obeyed, within a range of strain which is determined by the purity and grain size of the lead. The region within which the $t^{1/3}$ law holds, here called stage FI, is succeeded by stage FII, during which the strain increases according to a logarithmic law, the creep rate being proportional to the increase in strain. In stage FIII, which begins at a strain of about 0.3, the creep is strictly linear until the strain approaches 2.0, when rupture starts. If the stress be reversed while stage FI is in progress a creep linear with time takes place, at a rate which is twice that of the forward creep at the moment of reversal, and this constant rate continues for a time equal to that of the forward creep. This initial stage R_0 is succeeded by a stage RI which is also governed by a $t^{1/3}$ law, the constant multiplying $t^{1/3}$ being proportional to that for stage FI at the same stress. This is followed by a stage RII in which the creep rate increases according to the same law which prevailed for stage FII, and this in turn is followed by a linear stage RIII characterized by the same constant creep rate as FIII. If the stress be reversed at a strain so large that the $t^{1/3}$ law has ceased to be valid, the reverse creep stages are markedly affected, which emphasizes the physical significance of the $t^{1/3}$ law. A law of corresponding times is enunciated, which connects the flow in stages R_0 and RI with that in stage FI. Photomicrographs and back-reflection X-ray photographs have shown that the $t^{1/3}$ flow is accompanied by progressive slip in the grains and local rotation of the lattice, and that in the R_0 stage slip takes place on the same slip bands as were active in the FI stage. Recrystallization and grain growth occur during stages FII and RII. In stages FIII and RIII there is a balance between grain break-up and grain growth, and the slip direction shows a preference for the directions of principal stresses. By considering the variation of strain rate with stress and temperature in stage III, constants have been derived which indicate that the flow in this quasi-viscous stage resembles that of a single crystal far more than that of a polycrystalline metal. The general implications of the experimental findings are discussed.

539.3

8122 ON THE CREEP, RECOVERY, RELAXATION AND ELASTIC "MEMORY" OF SOME RENNETED MILK GELS. G.W.S.Blair and J.Burnett.

Brit. J. appl. Phys., Vol. 10, No. 1, 15-20 (Jan., 1959).

Small pressures are applied to one end of a column of renneted milk gel ("curd") in a U-tube and the displacements at the other end are magnified a hundredfold. As a first approximation, the curd behaves as a Burgers Body, except that the creep curve shows a much greater "rapid" strain than does the recovery curve. Relaxation at constant strain follows as power relation between stress and time with an exponent of 0.40. The time taken for the stress to halve itself is proportional to the initial (rapid) rate of straining. Under selected conditions, creep and relaxation curves during ageing approximate to Boltzmann's Superposition Principle. Hysteresis curves, obtained by repeated loading and unloading, show marked stiffening, followed by a (Bauschinger) softening when the direction of loading is reversed. Following suitable stressing in alternate directions, curd shows "elastic memory," i.e. the recovery curves change direction. Such behaviour necessitates additions to the Burgers model. A modification of Boltzmann's Superposition equation is discussed and Graham's equation, which includes an Andrade term, has been applied to some of the data. The relative significance of the analytical and integrative approaches to these problems is considered.

539.3

8123 DISTRIBUTION OF RELAXATION TIMES IN A SYMMETRICALLY STRESSED RENNETED MILK GEL.

G.W.S.Blair and J.Burnett.

Brit. J. appl. Phys., Vol. 10, No. 2, 97-9 (Feb., 1959).

Applying the graphical method of the "Central Limit Theorem", it is found that repeated relaxation experiments on suitably prepared renneted milk gels indicate a log-normal distribution of relaxation times, under optimal temperature conditions. This depends on minimizing strain-stiffening by alternating the direction of the stresses and also on the use of a particular convention for fixing the time zero. The disparity between the immediate elastic displacement of these gels under load and the immediate part of their recovery, previously ascribed to a type of thixotropy, is now explained in terms of static fatigue.

539.4

8124 THE HARDENING OF COPPER SINGLE CRYSTALS BY FATIGUE.

T.Broom and R.K.Ham.

Proc. Roy. Soc. A, Vol. 251, 186-99 (May 26, 1959).

Copper single crystals have been subjected to alternating stresses of such magnitude as would cause complete fatigue failures in 5×10^5 cycles. Slip striations are produced both at 78° and 293° K and plastic deformation starts in these regions if partially fatigued specimens are extended. In specimens fatigued at 293° K the material between striations begins to deform at a significantly higher stress than the maximum stress applied during fatigue and yield point phenomena are observed. The flow stress of the yield extension has a strong temperature dependence. Yield point phenomena are less pronounced in specimens fatigued at 78° K and additional hardening can be produced in such specimens if they are warmed after fatigue to temperatures higher than 200° K. These observations suggest that point defects make a substantial contribution to the hardening which is observed during fatigue tests at room temperature.

539.4 : 550.3

8125 FAULTS IN A MATERIAL THAT HARDENS WHEN IT YIELDS.

H.Jeffreys.

Proc. Roy. Soc. A, Vol. 252, 431-5 (Oct. 27, 1959).

The problem of an elliptical rigid inclusion in an elastic solid with homogeneous stress at a large distance, is solved. The greatest stress differences are found to be at or near the ends of the flaw and to be determined mainly by the greatest principal stress. The result differs from that of G.I.Taylor (1934) for flaws filled with compressible but weak material, where the greatest stress-differences, for similar but differently oriented flaws, would occur for flaws at 45° to the greatest principal stress. The result would suggest that in dynamic metamorphism of rocks weak crystals would tend to form at 45° and strong ones would tend to form needles parallel to the greatest principal stress. Doubts are expressed about this interpretation, and an alternative is suggested, namely, that stress has little to do with the formation of minerals, but that they are sheared and rotated into parallel directions by flow in the surrounding rock after they are formed.

539.4

8126 THE DEPENDENCE OF LIFETIME UNDER LOAD ON APPLIED STRESS FOR SINTERED SPECIMENS OF IRON IN THE ALPHA- AND GAMMA-PHASES.

B.Ya.Pines and A.F.Sirenko.

Dokl. Akad. Nauk SSSR, Vol. 129, No. 2, 310-13 (Nov. 11, 1959). In Russian.

This paper concerns the diffusion mechanism for crack growth and fracture proposed by Pines [Zh. tekh. Fiz., Vol. 25, No. 8, 1399 (1955)], and supported by previous experiments of the authors (see Abstr. 1866 of 1960). The activation energy is related primarily to that of self-diffusion (and not to that of sublimation, as proposed by Zhurkov on purely experimental grounds [S.N.Zhurkov and B.N.Narzulaev, Zh. tekh. Fiz., Vol. 23, No. 10 (1953); S.N.Zhurkov and T.P.Sanfirova, Dokl. Akad. Nauk SSSR, Vol. 101, No. 2, 237 (1955)]). Zhurkov has since claimed to disprove the theory by experiments with Ag-Al alloys, in which these two quantities vary independently. The authors here reject this test, since their theory is not adequate for alloys, and they report alternative experiments on iron, which are held to confirm the theory. I.D.C.Gurney

539.4

8127 INTERSTITIALS AND FRACTURE OF METALS.

T.E.Scott and A.R.Troiano.

Nature (London), Vol. 185, 372-3 (Feb. 6, 1960).

A theory of delayed brittle fracture is outlined. The cohesive strength of the lattice is lowered by the formation of an uncondensed impurity atmosphere in the region of the critical stress state. The fracture crack can then propagate through this region of interstitials and then has to wait until the impurities regroup round the tip of the crack; the "delayed" fracture process thus continues. The analogy with strain ageing is discussed. R.Bulloug

539.

8128 AN INVESTIGATION OF THE FACTORS LIKELY TO AFFECT THE STRENGTH AND PROPERTIES OF GLA FIBRES.

W.F.Thomas.

Phys. Chem. Glasses, Vol. 1, No. 1, 4-18 (Feb., 1960).

Experiments were carried out to determine the effect of production conditions on the tensile strength of glass fibres. Withi the experimental range it is found that the strength in pounds per square inch is independent of the fibre diameter, a result at varian with that of previous workers. The breaking stress of a glass fibre is found to be constant provided the temperature of the molten glass from which the fibre is drawn is sufficiently high to permit a fibre of uniform diameter to be produced. The room temperature strengt of glass fibres decreases on annealing at temperatures as low as 100° C, and the rate of decrease of strength increases with increase of annealing temperature. At an annealing temperature below 300° C heating for at least 2 hours is required to reduce the tensile strength to a constant value. At higher temperatures the time effec is much smaller. At 600° C the strength of a fibre falls to a constan value immediately it is heated.

539.4 : 548

8129 THE CRITICAL STRESS FOR THE PRODUCTION OF PRESSURE CRACK FIGURES ON DIAMOND FACES.

V.R.Howes.

Proc. Phys. Soc., Vol. 74, Pt 1, 48-52 (July 1, 1959).

In recent papers static impact tests carried out on different diamond surfaces have been described. Here the quantitative results from these experiments are collected together and are then compared with theoretically derived values for the critical average stress for cracking to be initiated on the different diamond surfaces Both theoretical and experimental results show that the octahedral face is less resistant to cracking than the cubic face; but theoretica values obtained are of the order of 100 times greater than the corresponding experimental values. This, together with other consider tions, is thought to indicate experimentally some sort of flaw distribution in diamond.

539.5

8130 X-RAY EXAMINATION OF BRITTLE FRACTURES IN EXTRUDED CHROMIUM.

C.W.Weaver and K.A.Gross.

J. appl. Phys., Vol. 31, No. 4, 626-31 (April, 1960).

X-ray examinations of brittle fractures in polycrystalline chromium, produced at temperatures between 193° and 623° K, have bee made. Estimates of the amount of deformation present at the fracture surfaces showed that very large plastic strains were associate with brittle cleavage fracture at the higher temperatures, such that the length of a self-sustaining crack calculated according to the mod fied Griffith crack formula of Hall, was more than an order greater than the mean grain diameter of the material. Plastic strains of this order would be expected to result in ductile behaviour. It is su gested that brittle failure was caused by the presence of a fine dispersion of precipitate particles, which delayed the action of cross slip in sealing off the early stages of cracking. The spacing of the precipitate particles was estimated to be between 6000 and 7000 A.

539.3 : 539.2

THE DEFORMATION AND FRACTURE OF SINGLE-CRYSTAL GOLD FILMS. See Abstr. 8286

539.

8131 THE RELATIONSHIP BETWEEN SURFACE TEXTURE AND ROLLING RESISTANCE OF STEEL.

J.Halling.

Brit. J. appl. Phys., Vol. 9, No. 11, 421-8 (Nov., 1958).

The paper describes two series of experiments which were designed to investigate the relationship between the surface texture of ground mild steel surfaces and the resistance to rolling of hard steel rollers on these surfaces. In the first series of experiments the rollers were unloaded whilst in the second series of tests the rollers were subjected to a load range of 15-80 lb. In both cases it was found that the coefficient of rolling resistance increased with increasing roughness of the surface. By extrapolation of the result from the second series of tests, agreement with the results of the first series was obtained. The coefficient of rolling resistance was found to decrease with increasing load. The variation of the coefficient of rolling resistance with load is obtained in the form of a experimental law which is compared with the various theories of th mechanism of rolling resistance.

539.5

8132 EFFECT OF DEFORMATION OF THE SURFACE TEXTURE ON ROLLING RESISTANCE. J.Halling.

Brit. J. appl. Phys., Vol. 10, No. 4, 172-6 (April, 1959).

The results of a series of experiments showing the variation of the coefficient of rolling resistance λ, with increasing load for hard steel rollers on a variety of steel surfaces are given. It was found that the initial value of λ, and the rate of change of λ with increasing load, were both reduced by a series of loading cycles in which the maximum load in any given cycle exceeded the maximum load of the preceeding cycle. These changes were also found to be greater for the rougher surfaces. The effect of yield stress was also studied and increasing yield stress produced slightly larger values of λ. In all the tests a change of behaviour occurred at a load which was markedly dependent on the bulk yield stress of the material and marginally dependent on the surface roughness. The experimental results are interpreted in terms of the resistance to rolling being dependent on two factors; (a) the hysteresis loss concept, and (b) the requirement for the smooth roller to surmount the irregularities on the surface.

539.5

8133 HARDNESS—TEMPERATURE CHARACTERISTICS OF SOME SIMPLE GLASSES. J.H.Westbrook.

Phys. Chem. Glasses, Vol. 1, No. 1, 32-6 (Feb., 1960).

Micro-indentation hardness studies in vacuo on a number of simple glasses show a monotonic decrease in hardness with temperature for most glasses. Irregularities are observed for strong glasses such as fused silica; certain of these irregularities can be related to the structure and thermal history of the glass.

539.6

8134 APPARENT SLIP BETWEEN METAL AND RUBBER-COVERED PRESSURE ROLLERS. G.J.Parish.

Brit. J. appl. Phys., Vol. 9, No. 11, 428-33 (Nov., 1958).

Measurements are described which indicate that in a roller system consisting of a metal and a rubber-covered roller rotating in contact under load, the metal roller always has the higher apparent peripheral speed whether it is driving or is driven by the rubber roller. This behaviour is similar to that observed when a wheel or cylinder is rolled over a stationary surface, and is attributed to extension of the rubber surface in the region of the nip, the extension being due in part to the contact pressure and in part to the presence of shear strains consequent on the transmission of torque through the nip. The theoretical distribution of surface strain in the rubber due to the contact pressure is derived, and the theoretical results are found to be in fair agreement with the experimental. Some further experiments designed to measure the rubber extension are described.

539.6

8135 THE FRICTION OF MINERAL PARTICLES. R.T.Spurr.

Brit. J. appl. Phys., Vol. 9, No. 12, 486-7 (Dec., 1958).

The coefficient of friction of loose particles slid between parallel plates is approximately proportional to the Mohs hardness of the particles. The particles are crushed during sliding.

539.6

8136 JUNCTION GROWTH IN METALLIC FRICTION: THE ROLE OF COMBINED STRESSES AND SURFACE CONTAMINATION. D.Tabor.

Proc. Roy. Soc. A, Vol. 251, 378-93 (June 9, 1959).

This paper extends earlier work on the adhesion mechanism of friction and considers in particular the growth in area of contact as the tangential force is increased to the point at which gross sliding occurs. The earlier studies assumed that the area of true contact A is the same as that produced under static loading so that $A = W/p_0$ where W is the normal load and p_0 the plastic yield pressure of the metal. If the junctions have a specific shear strength s, the friction F, that is the force to shear them, will be F = As and the coefficient of friction becomes $\mu = s/p_0$. Recent studies, however, show that as the tangential stress is applied the area of true contact increases according to a relation of the type $p^2 + \alpha s^2 = p_0^2$ where p is the normal and s the tangential stress in the contact region and α an appropriate constant. With thoroughly outgassed metals, junction growth generally proceeds until practically the whole of the geometric area is in contact and coefficients of friction of the order of 50 or more are observed. If the interface is contaminated, the stresses transmitted through it cannot exceed the critical shear stress of the interface. The new point developed in this paper, based on the work of Courtney-Pratt and Eisner (1957), is that until the shear stress reaches this value junction growth occurs as for clean metals. Beyond this point, however, further junction growth is impossible and gross sliding occurs within the interfacial layer itself. The analysis given here shows that if the interface is only 5% weaker than the bulk metal, junction growth ceases and gross sliding occurs when the coefficient of friction is of the order of unity. This corresponds to the experimental observation that minute amounts of oxygen or air reduce the friction of thoroughly clean metals from extremely high values to values of about 1. In the presence of a lubricant film the transmissible stresses are so small that little junction growth can occur before sliding takes place. The expression for the coefficient of friction now reduces to a form resembling that given by the earlier simpler theory, namely $\mu = s_i/p_0$, where s_i is the critical shear stress of the lubricant layer. The present treatment thus incorporates the effect of combined stresses and surface contamination into a more general theory of metallic friction.

539.6

8137 THE FRICTION OF WOOD. D.Atack and D.Tabor.

Proc. Roy. Soc. A, Vol. 246, 539-55 (Aug. 26, 1958).

Earlier work, especially on metals, has shown that the friction of unlubricated solids is largely due to strong adhesion occurring at the regions of real contact; in addition part of the friction may arise from the ploughing of the softer surface by asperities on the harder. The authors show that the friction of wood may be explained in a similar way, that is it arises from an adhesion term and a deformation or ploughing term. In particular, it is found that the moisture content may have a profound effect — not necessarily a collateral one — on each of these terms. The friction was studied between balsam wood (Abies balsamea) and surfaces of steel and polytetrafluoroethylene (PTFE). The most revealing results are obtained when steel or PTFE spheres are slid or rolled over the wooden surface. The rolling friction is found to be due to internal friction or hysteresis losses in the wood and not to surface interaction. It is essentially the same for both steel and PTFE spheres. As the moisture content is raised from 0 to 30% the rolling friction increases and then remains constant; this is apparently due to changes effected in the mechanical rather than the surface properties of the wood. In contrast, the sliding friction is found to depend both on the moisture content of the wood and on the chemical nature of the other surface. For a hard slider of a given material under specified moisture conditions the sliding friction, F_S, may be expressed as the sum of two terms: $F_S = F_D + F_A$; F_D is the tangential force involved in deforming the wood and is directly related to the internal friction or hysteresis losses in the wood itself. It corresponds to the rolling friction. F_A is the tangential force required to overcome interfacial adhesion. This is specific to the surfaces. It is high for steel whatever the moisture content of the wood, showing that the adhesion, which is probably due to hydrogen bonding, is strong in both cases. For PTFE the friction is fairly high when the wood has a low moisture content, implying a relatively strong adhesion, but it is very low when the moisture content exceeds 30 to 40%. This emphasizes the importance of surface structure in the adhesion term of friction in contrast to the deformation term which is essentially a bulk phenomenon.

539.6

8138 THE FRICTION OF SOLIDS AT VERY HIGH SPEEDS. I. METAL ON METAL. II. METAL ON DIAMOND. F.P.Bowden and E.H.Freitag.

Proc. Roy. Soc. A, Vol. 248, 350-62, 362-7 (Nov. 25, 1958).

The friction of metal surfaces and of metals sliding on diamond at very high speeds has been studied. A ball spinning in vacuo at surface speeds up to 800 m/sec is trapped between symmetrically arranged flat plates so that the friction causes it to slow down. The deceleration is measured electronically and recorded. The results show that the sliding resistance of metals decreases as the speed increases and reaches very low values. There is evidence that frictional heating produces high surface temperatures and a softening and melting of the metal at the regions of contact. An analysis of the heat flow in a specimen shows that the area of intimate contact is very small compared with the apparent interface. Since the temperature falls very rapidly with increasing distance from the shearing zone the metal behaves like a combination of a thin film of low shear strength supported by a hard substrate. This can explain the low friction at high sliding speeds. It is also suggested that the real area of contact depends on the velocity with which plastic strains are propagated in the metal. The shearing occurs so rapidly that full plastic yielding under the normal load is not possible. Some metals disintegrate in a brittle fashion when a critical speed is exceeded. When metals slide on diamond even the hard octahedral face is abraded and polished if appropriately high sliding speeds are used. Metals with a high melting point are most effective in this polishing process and it is concluded that the wear of diamond is due to an allotropic transformation into graphite or amorphous carbon under the influence of localized frictional heating.

539.6

8139 POLISHING OF CRYSTALS IN RELATION TO THEIR PHYSICO-MECHANICAL PROPERTIES.

N.N.Kachalov and L.F.Grigor'eva.
Dokl. Akad. Nauk SSSR, Vol. 129, No. 5, 1012-15 (Dec. 11, 1959). In Russian.

Single crystals of Ge, Si and corundum, and polycrystalline specimens of metallic compounds with zinc-blende structure were polished with diamond, boron and silicon carbides, and alumina powders, and the effect of various factors (particle size of the polishing media, pressure, polishing speed, orientation of the polished specimens) on some parameters of the polishing operation (efficiency, consumption of the polishing media, thickness of the "relief" and disturbed layers) was studied. Relationships, essentially identical with those applicable to polishing of glasses, were established. M.H.Sloboda

539.6

8140 THE POLISHING, SURFACE FLOW AND WEAR OF DIAMOND AND GLASS. F.P.Bowden and H.G.Scott.

Proc. Roy. Soc. A, Vol. 248, 368-78 (Nov. 25, 1958).

It has been shown that a diamond sliding on glass can under suitable conditions induce surface flow of the glass. The speed (v) and load (W) necessary to cause this flow have been studied and it is found that flow only occurs if $v\sqrt{W}$ exceeds a critical value which depends on the type of glass. There is evidence that flow occurs when a critical surface temperature is reached and approximate calculations indicate that this temperature corresponds to the softening point of the glass. It is suggested that this type of thermal softening and flow may occur on a submicroscopic scale when glass is polished. Heavy wear of a diamond sliding on glass has been observed. This wear is very dependent on the humidity of the atmosphere; in a dry atmosphere it may be 100 times greater than it is in a humid one. The wear rate on glass in dry air is greater than that on a scaife (diamond impregnated grinding wheel). The wear is accompanied by the production of a detritus of amorphous carbon so that the process appears to be primarily one of degradation of diamond to amorphous carbon. This degradation is aided by the temperature rise at the rubbing interface and there is evidence that it can occur at temperatures lower than those required when the diamond is heated without rubbing.

539.6

8141 THE ABRASION OF DIAMOND.

M.Seal.
Proc. Roy. Soc. A, Vol. 248, 379-93 (Nov. 25, 1958).

The process is unusual in that there is a very large directional variation in the resistance to abrasion of diamonds abraded with diamond powder. The wear rates for different crystallographic directions vary by a factor of 500 or more. An attempt has been made to determine whether the abrasion of diamond by diamond occurs by fragmentation on a microscopic scale, or by burning or an allotropic change caused by the local high temperatures produced by friction. The experimental work described is in two sections: track formation on diamond, and the friction of diamond. The work on track formation, carried out at low sliding speeds with a rounded diamond slider and a plane diamond surface, was done in an attempt to reproduce on a macroscopic scale the damage occurring on a microscopic scale during abrasion. It was found that, according to the conditions of sliding, tracks of three main types can be produced, and that on an individal diamond face there is no variation of the ease of track formation with sliding direction, indicating that high sliding speeds introduce some effect which causes the anisotropy in abrasion resistance. A thermally activated chemical effect is thought to be the most likely cause of this difference in behaviour at high and low sliding speeds, and the following explanation of the anisotropy in high-speed wear rate is suggested. The work on friction shows that there is a variation with sliding direction of the coefficient of friction between diamond and diamond. Directions in which the friction can be high are directions of easy abrasion. The local surface temperatures during abrasion will depend on the coefficient of friction and will be greater when the friction is high. These directions would thus be excepted on a thermal theory to be those of easy abrasion. Further-more, a small anisotropy in friction would account for a large anisotropy in abrasion resistance.

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8142 PITS IN METALS CAUSED BY COLLISION WITH LIQUID DROPS AND RIGID STEEL SPHERES.

O.G.Engel.
J. Res. Nat. Bur. Stand., Vol. 64A, No. 1, 61-72 (Jan.-Feb., 1960).

For previous work, see Abstr. 10339 (1959). The equation fo pit depth as a function of collision velocity was tested further wit experimental data obtained using target plates of electrolytic tough pitch copper, 1100-O aluminium, and 2024-O aluminium, the stati strength properties of which were measured by testing tensile specimens. The projectiles used to produce the pits were mercury drops, waterdrops, and steel spheres. It was found that the numerical constants in the equation for projectiles that flow during and as a result of the collision are different from those for projectiles that do not flow (hardened steel spheres). Curves calculated using the equation were found to be in acceptable agreement with experimental pit-depth v. velocity data for collisions of the indicated pro tiles with target plates of the three metals used with the exception of the case of steel-sphere impingement against 2024-O aluminium alloy. In this case work-hardening of the target metal seems to foster a mode of pit formation that was not considered in the development of the equation.

539.

8143 FORMATION AND INITIAL GROWTH OF SINGLE-ASPERITY SOLID-STATE BONDS.

F.C.Holden, J.B.Melehan, H.R.Ogden and R.I.Jaffee.
J. appl. Phys., Vol. 31, No. 4, 670-3 (April, 1960).

A gold needle point in contact with a gold flat has been used to study the formation and initial growth of single-asperity solid-state bonds. In the absence of external pressure, the growth of the bonded area can be expressed analytically by a diffusion-controlled rate equation. Values for the coefficient of self-diffusion determine from these experiments are in reasonable agreement with those given in the recent literature.

539.

8144 MEASUREMENT OF ADHESION OF THIN FILMS.

P.Benjamin and C.Weaver.
Proc. Roy. Soc. A, Vol. 254, 163-76 (Feb. 9, 1960).

Methods of measuring adhesion are considered and an analysis is presented of a method which is particularly suitable for thin films. In this method a rounded steel point of smooth contour is drawn across the film surface and the load on the point is gradually increased until the film is removed, leaving a clear channel. It is shown experimentally that the load required depends upon the nature of the interface between film and substrate without being directly dependent upon the mechanical properties of either. The method is analyzed in detail and a suitable mechanism is proposed. This mechanism is examined both theoretically and experimentally and it is shown that an absolute value of the shearing force required to remove a film can be calculated from the critical load required, the tip radius of the point and the identation hardness of the substrat Applications have been restricted so far to metal films on transparent substrates.

539.6

8145 ADHESION OF METAL FILMS TO GLASS.

P.Benjamin and C.Weaver.
Proc. Roy. Soc. A, Vol. 254, 177-83 (Feb. 9, 1960).

The adhesion of metal films produced by vacuum evaporation was measured by drawing a smoothly rounded chrome-steel point across the surface and gradually increasing the load on the point until the film was removed. Results are presented for gold, iron and aluminium. In the cases of iron and aluminium, ageing effects were observed which vary with the residual oxygen concentration. The differences between the ageing curves are explained in terms of the film structures as obtained by electron microscopy. The results indicate that iron and aluminium are both strongly bonded to the glass by an intermediate oxide layer, whereas gold does not form such a layer and is held by van der Waals forces only.

CRYSTALLOGRAPHY

CRYSTAL STRUCTURES

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8146 ORIENTATION DENSITY AND ITS USE IN QUANTITATIVE TEXTURE STUDIES.

C.G.Dunn and J.L.Walter.

appl. Phys., Vol. 31, No. 5; 827-33 (May, 1960).

An equation is derived from a definition of orientation density, $Q = \delta\zeta/1.4\rho^3$, where Q is the average orientation density in an orientation state of size ρ centred on a particular orientation and ζ is the measured volume fraction of the sample with orientations within the orientation state. An approximate relationship between orientation density and (100) pole density for a strong single component texture is obtained, namely $Q_0 = 1.08P_0^{3/2}$, where Q_0 is the maximum orientation density and P_0 is the maximum pole density. Samples that include the orientations of a large number of grains are used to illustrate the application of orientation density to the study of textures. Orientation density results are considered to be especially valuable when the texture has many components.

539.2 : 548

8147 THE CRYSTAL CHEMISTRY OF THE AMPHIBOLES.

E.J.W.Whittaker.

Acta cryst., Vol. 13, Pt 4, 291-8 (April, 1960).

The amphiboles are important rock-forming silicate minerals with a perfect prismatic cleavage. The major differences in unit-cell shape of the different amphibole varieties and the respective composition ranges of the orthorhombic and monoclinic amphiboles, are related to the effects of the ionic radius of the ions occupying two of the sets of ionic sites in the structure. These are the ions which serve to link together the talc-like strips from which the structure may be regarded as being built. The reason for the existence of both limited and unlimited isomorphous substitution ranges for the same ions in different parts of the composition field is shown to depend on the different effects on chain packing of the radius of the ions occupying these two sites as compared with each other and with the sites which are wholly inside the talc-like strips.

539.2 : 548.5

8148 ON TWISTED ORGANIC CRYSTALS.

A.L.McClellan.

. chem. Phys., Vol. 32, No. 4, 1271-2 (April, 1960).

Crystals of soap from lubricating grease, when seen in the electron microscope, have the appearance of twisted fibres. Two forms are observed; (i) "helicord" (twisted ribbon) (ii) true helix or two-strand "rope". As in the case of the twisted LiF fibres reported by Sears (Abstr. 9004 of 1959) the shapes can be satisfactorily explained by means of the equations due to Eshelby (Abstr. 3711 of 1953; 3518 of 1958). The two forms are illustrated in electron-micrographs. J.Iball

539.2 : 548.5

8149 VACUOLE DISAPPEARANCE TEMPERATURES OF LABORATORY-GROWN HOPPER HALITE CRYSTALS.

D.S.McCulloch.

J. geophys. Res., Vol. 64, No. 7, 849-54 (July, 1959).

When halite is grown above room temperature and cooled, vacuoles are produced in the crystal's fluid inclusions owing to the contraction of the fluid. Upon reheating, the vacuoles disappear, presumably at the growth temperature. In order to correlate growth and vacuole disappearance temperature, halite crystals were grown at controlled temperatures by evaporation of sea water in a constant-temperature oven. The highest (and usually presumed to be the most accurate) disappearance temperatures of the vacuoles are above the growth temperature for the halite grown below about 72° C, and below the growth temperature for the halite grown above about 72° C. It is suggested that anomalously high disappearance temperatures may be due to the presence of CO_2, whereas vacuole disappearance temperatures below growth temperatures may be due to leakage of brine into liquid inclusions.

539.2 : 548.5

8150 HABIT PLANES FOR U_4O_9 PRECIPITATION IN URANIUM DIOXIDE.

R.H.Tuxworth and W.Evans.

J. nuclear Mater., Vol. 1, No. 3, 302-3 (Oct., 1959).

539.2 : 548.5

8151 THE INFLUENCE OF TEMPERATURE AND SUPERSATURATION ON THE HABIT OF ICE CRYSTALS GROWN FROM THE VAPOUR.

J.Hallett and B.J.Mason.

Proc. Roy. Soc. A, Vol. 247, 440-52 (Oct. 21, 1958).

Ice crystals, growing on a fibre in a water-vapour diffusion cloud chamber under conditions in which the temperature and supersaturation of the environment can be varied independently, undergo the following transitions of habit in the temperature range 0 to −30° C: plates → needles → hollow prismatic columns → plates → dendritic crystals → plates → prismatic columns. These changes of habit are controlled mainly by the temperature of the environment, large variations of supersaturation influencing only secondary features such as the development of dendritic forms. When crystals growing at a particular temperature are suddenly transferred into a different environment, further growth follows the habit characteristic of the new conditions; this allows the production of crystals of composite habit. In contradiction to a recent report by Nakaya, the crystal habit does not appear to be influenced by the presence or absence of atmospheric aerosols, but small quantities of organic vapours, e.g. camphor and isobutyl alcohol, modify the habit to an extent depending upon their concentration.

539.2 : 548.5

8152 COMMENTS ON THE PAPER OF HALLETT AND MASON.

J.D.Bernal.

Proc. Roy. Soc. A, Vol. 247, 534-8 (Oct. 21, 1958).

539.2 : 548.5

8153 THE HETEROGENEOUS AND HOMOGENEOUS NUCLEATION OF SUPERCOOLED WATER.

E.J.Langham and B.J.Mason.

Proc. Roy. Soc. A, Vol. 247, 493-504 (Oct. 21, 1958).

In extension and confirmation of the work of Bigg, observations on the freezing of large numbers of drops of distilled water, ranging from 10 μ to 1 cm in diameter and suspended at the interface of two immiscible liquids in order to avoid the nucleating effects of solid surfaces, have established proportionality between the logarithm of the droplet volume and its freezing temperature for a constant rate of cooling. Such a relationship appears to characterize the heterogeneous nucleation of water droplets containing small foreign nuclei, and it is interpreted in terms of the droplets being infected with atmospheric aerosols whose ice-nucleating ability is known to increase roughly logarithmically with decreasing temperature. A technique has been developed for purifying water so that drops of up to 1 mm diameter may be supercooled to temperatures at which freezing occurs spontaneously without the aid of foreign nuclei. The empirical relationship between droplet volume and nucleation temperature, which differs from that representing heterogeneous nucleation, shows good agreement with theory. Photographs taken of freezing droplets upwards of 50 μ in diameter reveal that, in some cases, solidification was accompanied by rupture of the ice surface and the liberation of a number of small ice splinters. This suggests a secondary mechanism of ice crystal formation in natural clouds.

539.2 : 548.5

8154 STUDY OF CADMIUM SULPHIDE CRYSTALS GROWN FROM THE VAPOUR PHASE IN A STREAM OF ARGON.

J.Woods.

Brit. J. appl. Phys., Vol. 10, No. 12, 529-33 (Dec., 1959).

Crystals of cadmium sulphide have been grown by reacting a stream of argon containing cadmium vapour with a stream of hydrogen sulphide. The variations in crystal habit which occur are very similar to those reported for ice crystals by Hallett and Mason (see preceding abstracts). Growth features were studied using a metallurgical microscope. Although growth occurs in layers, spirals were only observed on rare occasions. The evidence indicates that ordinary two-dimensional nucleation over a plateau is more common, and is affected by the impurities added. Nucleation also occurs at sites on the edge of a crystal face or at the apexes of re-entrant angles between growth steps from neighbouring sources. Various types of cavity have also been observed in the volume of some crystals, and possible methods of formation are discussed.

539.2 : 548.5

8155 THE CRYSTALLOGRAPHY OF DEFORMATION TWINNING.

M.A.Jaswon and D.B.Dove.

Acta cryst., Vol. 13, Pt 3, 232-40 (March, 1960).

The crystallography of deformation twinning is formulated on a fresh mathematical basis. This leads to a simplified technique for calculating the reciprocal elements corresponding to a given pair of rational twinning elements. It is shown how the scale of homogeneity of the deformation may be deduced from macroscopically available data. A new analysis is presented of the atomic displacements involved in rotation twinning. Criteria are laid down for the selection of operative twinning modes out of all those mathematically admissible.

539.2 : 548.5

8156 TWINNING CAUSED BY ABRASION ON SINGLE CRYSTALS OF BERYLLIUM. V.D.Scott.

Acta cryst., Vol. 13, Pt 4, 313-19 (April, 1960).

New results concerning the lattice re-orientation caused by abrasion on single crystals of beryllium have been obtained by electron diffraction. The occurrence of twinning found in certain cases in sub-surface regions of abraded single-crystal beryllium surfaces was dependent upon the initial crystal orientation with relation to the direction of the applied compressive stresses. The operative $\{10\bar{1}2\}$ set of twinning planes was found to be the one which most facilitated development of the characteristic oblique [001] compression fibre texture produced by the abrasion in the outermost surface layers by rotational slip or flexural rotational slip of the sub-surface twin.

539.2 : 548.5

8157 DYNAMIC EFFECTS IN REFLECTION PATTERNS OF LAYERS OF COPPER CONTAINING SEVERAL TWINS.

J.J.Couderc, J.Garigue, L.Lafourcade and Nguyen Quat Ti.
C.R. Acad. Sci. (Paris), Vol. 249, No. 23, 2523-5 (Dec. 9, 1959).
In French.

The effect of twins in evaporated copper layers on the resulting diffraction pattern observed in the $\langle 110 \rangle$ direction is briefly described. Supplementary spots appear in the diagram and these can be explained by considering relations between three vectors representing the original lattice and those of the two types of twin respectively. A.E.I. Research Laboratory

539.2 : 548.5

8158 STUDIES ON AMMONIUM TITANYL SULFATE. S.Taki.

J. Sci. Hiroshima Univ. A, Vol. 23, No. 2, 281-301 (Dec., 1959).

Fundamental studies on ammonium titanyl sulphate were carried out to prepare feed material with appropriate properties for the synthesis of rutile single crystals by a flame fusion technique. A more advantageous procedure for the preparation of ammonium titanyl sulphate crystals was devised. Crystals of two different forms were obtained according to the conditions of crystallization. The rate of crystallization was affected by temperature, and the content of chlorine in the mixture of titanium tetrachloride and sulphuric acid. The solubilities in the solutions of sulphuric acid or hydrochloric acid were determined. The mechanism of contamination of ammonium titanyl sulphate with impurities during the crystallization process is discussed. The water-binding mechanism in the ammonium titanyl sulphate hydrate was made clear from the observations of proton magnetic resonance and infrared absorption spectra. The complicated process of the thermal decomposition and the rate of dehydration were investigated. Titanium dioxide obtained by the thermal decomposition of ammonium titanyl sulphate showed crystal growth with remarkable changes of shape. Calcination of ammonium titanyl sulphate was carried out to obtain titanium dioxide with appropriate physical properties as a feed material at various temperatures by two different methods.

539.2 : 548.5

8159 GROWTH HABIT OF SINGLE POLYMER CRYSTALS. F.P.Price.

J. chem. Phys., Vol. 31, No. 6, 1679-80 (Dec., 1959).

The constant thickness of the platelets and the inverse dependence of thickness upon temperature are explained in terms of growth from nuclei formed on the growing faces. See following abstract. A.R.Stokes

539.2 : 548.5

8160 FORMATION OF POLYMER CRYSTALS WITH FOLDED CHAINS FROM DILUTE SOLUTIONS.

J.I.Lauritzen, Jr and J.D.Hoffman.
J. chem. Phys., Vol. 31, No. 6, 1680-1 (Dec., 1959).

A preliminary note on the calculation of the rate of crystal growth in the case in which a fold in the chain backbone is needed to produce nucleation. See following abstract for the detailed account. A.R.Stokes

539.2 : 548.5

8161 THEORY OF FORMATION OF POLYMER CRYSTALS WITH FOLDED CHAINS IN DILUTE SOLUTION.

J.I.Lauritzen, Jr and J.D.Hoffman.
J. Res. Nat. Bur. Stand., Vol. 64A, No. 1, 73-102 (Jan.-Feb., 1960)

A detailed interpretation of the kinetics of homogeneous nucleation and growth of crystals of a linear homopolymer from dilute solution is given. The probability of forming both nuclei with folded chains, and conventional bundlelike nuclei, from dilute solution is analyzed. It is predicted that at sufficiently high dilution, critic nuclei of length I_p^* will be formed from single polymer molecules b sharp folding of the chain backbone. The step height of the nucleus is given approximately by $I_p^* = 4\sigma_e/\Delta f$. Here σ_e is the free energy required to form a unit area of the loop-containing end surfaces, a Δf is the free energy difference per unit volume of crystal between the crystalline and solution states. The quantity Δf is approximate proportional to the degree of supercooling ΔT. The growth of thes nuclei is then analyzed. After growth, the resulting crystal is flat and platelike, the loops formed by the chain folds being on the uppe and lower surfaces. Kinetics factors determine that the distance between the flat surfaces in the grown crystal will vary over only a narrow range about a value that is in the vicinity of $1^* = 4\sigma_e/\Delta f$. (Neglecting effects due to edge free energies, the theoretical upper and lower limits are $1^* = 4\sigma_e/\Delta f$ and $1^* = 2\sigma_e/\Delta f$, respectively). I some cases the predicted temperature dependence of the step heigh of the grown crystal, $1^* = \text{const.}/\Delta T$, may be modified by the existence of a constant term resulting from the presence of an edge fre energy ϵ_p. A grown loop-type crystal is predicted to be stable in c parison with a bundlelike crystal of the same shape and volume in a sufficiently dilute solution. The logarithm of the nucleation rate is approximately proportional to $1/(\Delta T)^2$ near the melting point. The exponent n in the free growth rate law is predicted under various assumptions. To the extent that comparison is possible, the predictions given agree with the experimental results obtained by Keller and O'Connor [Discussions, Faraday Soc. Vol. 25, P. 114 (1958)] and others on single crystals of unbranched polyethylene grown from dilute solution. A survey is given of homogeneous nucleation in bulk polymers, where the conventional bundlelike nucleus containing segments from many different molecules is valid and the essential results compared with those calculated for the dilute solution case. The theory given for loop nuclei is both gener and precise enough at the critical points to suggest that, on crystallization from sufficiently dilute solution, crystals of a definite step height are commonly to be expected for other crystallizable linear polymers than polyethylene, provided loop formation is sterically possible.

539.2 : 548.

8162 SPIRAL GROWTH OF COLLOIDAL GOLD AND MOIRÉ FRINGE. E.Suito and N.Uyeda.

Nature (London), Vol. 185, 453-4 (Feb. 13, 1960).

In the majority of examined crystals a small hole was found at the centre of the spiral. The ridge can be followed from the centre to the perimeter and back to the centre at the other side of the crystal. A three dimensional configuration of the crystal is suggested. Frank's relationship (see Abstr. 1311 of 1952) between the hole diameter and the strength of Burgers vector holds if the step height corresponds directly to the Burgers vector. J.Adam

539.2 : 548.

8163 PREPARATION AND PROPERTIES OF ZnS-TYPE CRYSTALS FROM THE MELT. A.G.Fischer.

J. Electrochem. Soc., Vol. 106, No. 9, 838-9 (Sept., 1959).

An estimate of the vapour pressure of ZnSe and CdS was obtain by sealing the material into evacuated quartz tubes and heating in a autoclave at different pressures; at the melting point the plastic quartz tube was deformed if the decomposition pressure was greate than that in the autoclave. As the vapour pressure is low (ZnSe, 1.8 atm) at the melting point, single crystals can be grown by containing the melt in quartz tubes fitted into graphite cylinders which support the quartz tubes and cooling through a known temperature gradient. ZnS can also be grown using zirconia crucibles sealed in quartz tubes and heated in an autoclave. Undoped ZnSe and samples doped with Al and In are n-type and photoconducting whereas Cu an Ag doped are p-type. J.E.Caffy

539.2 : 548.

8164 GROWING LARGE SINGLE CRYSTALS OF Zn WITH A GIVEN ORIENTATION. B.N.Buschmanow.

Exper. Tech. der Phys., Vol. 7, No. 5, 234-8 (1959). In German.

A survey is given of published methods, together with experimental details of the author's method. J.Thewli

539.2 : 548.5

8165 SIMPLE DEVICE FOR GROWING CRYSTALS AT LOW TEMPERATURES IN X-RAY CAMERAS.

M.A.Viswamitra and S.Ramaseshan.
Rev. sci. Instrum., Vol. 31, No. 4, 456-7 (April, 1960).

539.2 : 548.5

8166 GROWTH OF GALLIUM ARSENIDE BY HORIZONTAL ZONE MELTING.

J.L.Richards.
J. appl. Phys., Vol. 31, No. 3, 600-3 (March, 1960).

The growth of single crystals of GaAs is discussed with reference to the horizontal zone melt technique. The crystalline perfection and polarity of grown crystals can be determined from a study of edge dislocations revealed on {111} by an HF, H_2O_2 etchant. Evidence of good thermal control during crystal growth is found from a correlation between the incidence of dislocations and the shape of the freezing interface. Dislocation densities can be reduced to a very low order by careful control of growth conditions.

539.2 : 548.5

8167 ZONE REFINING AND CHEMICAL ANALYSIS OF KCl AND KBr.

S.Anderson, J.S.Wiley and J.Hendricks.
J. chem. Phys., Vol. 32, No. 3, 949-50 (March, 1960).

539.2 : 548.5

8168 TERMINAL ZONE CROPPING AND ULTIMATE ZONE PURIFICATION.

L.Gold.
J. Phys. Soc. Japan, Vol. 14, No. 3, 386 (March, 1959).

Discusses the explicit degree of purification achieved after any number of passes. The cumulative total fraction of impurity potentially removable in the terminal zone, ignoring back reflection of impurity from this zone, is expressed by a purification factor

$$P_T = 1 - \frac{1}{c\,L}\int_0^{L-l} c_n(x)dx$$

where c_0 is initial impurity concentration, L is ingot length, l is zone length and $c_n(x)$ is the positional impurity concentration after the n-th pass. W.Bardsley

539.2 : 548.5

8169 ATTEMPTS TO PURIFY METALS BY ARC ZONE MELTING.

G.Cabane.
J. nuclear Energy, Vol. 6, No. 4, 269-74 (May, 1958). In French.

The most reactive metals can be melted without contamination by arc-melting on a water-cooled copper hearth. For the purification of these metals, the zone melting process has been applied with an apparatus in which a zone of a metallic rod resting in the groove of a copper hearth is melted by a tungsten arc. Efficiency of arc zone melting has been checked for uranium, zirconium, and thorium purification. Advantages and limitations of the process are outlined.

539.2 : 548.5 : 621.365.4

8170 APPARATUS FOR THE ZONE REFINING OF COPPER.

E.D.Tolmie.
J. sci. Instrum., Vol. 37, No. 5, 175-7 (May, 1960).

An apparatus has been constructed to enable a small molten zone to be formed and maintained at a constant length while being made to travel along a copper bar. Zone-refining performance is indicated for commercial o.f.h.c. copper after ten passes with speed of travel 11 mm/hr.

539.2 : 548.5

8171 DISLOCATION ETCH PITS ON P-TYPE LEAD TELLURIDE.

B.B.Houston and M.K.Norr.
J. appl. Phys., Vol. 31, No. 3, 615-16 (March, 1960).

Details are given of two etches and the etching process used. Experiments indicate that the pits produced mark points where dislocations intersect the surface. Figure shows patterns on opposite faces of the same cleavage. There is almost one to one correspondence but no relation between sizes of corresponding pits. Techniques must be used on surfaces unspoiled by mechanical damage or chemical contamination. R.Berman

539.2 : 548.5

8172 ORIGIN OF THE "FIRST-ORDER STRUCTURE" OF CP4-ETCHED Ge SURFACES.

G.Bonfiglioli, A.Ferro and A.Mojoni.
J. appl. Phys., Vol. 31, No. 4, 684-6 (April, 1960).

A brief report of the results of examinations of surfaces of CP4-etched Ge is given. The origin of the so-called "1st-order structure" observed on the micrographs is discussed. It is shown that, while etching proceeds, the ending points of some dislocations are reached, or some of them become passivated. In both cases, the etch pits no longer grow and their traces give origin to the 1st-order structure.

539.2 : 548.5

8173 ETCHING OF SURFACES WITH 8-keV ARGON IONS.

R.L.Cunningham, P.Haymann, C.Lecomite, W.J.Moore and J.J.Trillat.
J. appl. Phys., Vol. 31, No. 5, 839-42 (May, 1960).

Methods of optical and electron microscopy were used to study the effects on solid surfaces of bombardment with argon ions of 8-keV energy. The targets were crystals of aluminium, zinc and α-corundum, and polycrystalline gold and aluminum. At oblique ionic incidence, etch hillocks were formed that were invariably oriented along the surface component of the direction of the ionic beam. Crystals were etched by ionic bombardment while being heated at elevated temperatures; this technique revealed dislocations widely spaced along the direction of growth in aluminum crystals.

539.2 : 548.5

8174 THE ROLE OF ELECTRICAL FORCES IN THE PROCESS OF CLEAVING OF MICA.

D.V.Deryagin and M.S. Metsik.
Fiz. tverdogo Tela, Vol. 1, No. 10, 1521-8 (Oct., 1959). In Russian.

The paper gives a useful review of the work on splitting mica. New experiments are described in which a wedge is pushed through mica at various velocities and variations of the distance of commencement of the split from the edge of the wedge is noted. The wedge is drilled through and an insulated probe is passed through to the wedge surface so as to be in close contact with the newly formed mica surface obtained on cleavage. With increase of wedge velocity there is a many-fold increase in the potential developed at the probe. The electric charges produced on cleavage are of the order of several tens of absolute e.s.u. per cm^2. It is concluded that the various effects observed in cleaving mica, also the emission of fast electrons in cleaving certain crystals, show that electrical forces are very much involved with the process of splitting. C.R.S.Manders

539.2 : 548.7

8175 SUMMARIZED PROCEEDINGS OF A CONFERENCE ON X-RAY ANALYSIS— MANCHESTER, APRIL 1958.

A.Hargreaves and E.Stanley.
Brit. J. appl. Phys., Vol. 10, No. 3, 116-24 (March, 1959).

The annual Spring Conference of the X-ray Analysis Group of The Institute of Physics was held at Manchester on 18 and 19 April, 1958. The papers and discussions ranged over a wide field including structural studies, apparatus and techniques of analysis.

539.2 : 548.7

8176 APPARATUS DRAWINGS PROJECT. REPORT NUMBER 6. BRAGG DIFFRACTION APPARATUS.

R.G.Marcley.
Amer. J. Phys., Vol. 28, No. 5, 415-17 (May, 1960).

The apparatus described is a macroscopic crystal-lattice analogue which may be used for a quantitative investigation of the Bragg law of diffraction. 3 cm microwaves are used rather than expensive and dangerous X-ray equipment. The data obtainable agree with the theory to within 10%.

539.2 : 548.7

8177 AUTOMATIC SINGLE CRYSTAL DIFFRACTOMETRY. I. THE KINEMATIC PROBLEM.

J.Ladell and K.Lowitzsch.
Acta cryst., Vol. 13, Pt 3, 205-15 (March, 1960).

Counter and crystal motions are coupled to explore the reflection space of a crystal along parallel lines in the reciprocal lattice by utilizing any one of three mechanical linkage mechanisms described here. The kinematic relations among the moving elements of each of the mechanisms are derived. These relations are used to evaluate the feasibility of these mechanisms as bases for automatic diffractometers.

539.2 : 548.7

8178 AN AXIAL RETIGRAPH.

A.L.Mackay.
Acta cryst., Vol. 13, Pt 3, 240-5 (March, 1960).

A retigraph, an X-ray diffraction camera recording on film an undistorted projection of one plane of the reciprocal lattice of a crystal, has been constructed with some novel features. The mapping of the remainder of the reciprocal lattice on to the film plane is analysed together with other aspects of the camera geometry which also applies to the precession camera. The Lorentz and polarization corrections, both for polarized and for unpolarized incident radiation, are calculated. Methods of setting such instruments employ characteristic spots or Laue streaks.

539.2 : 548.7

8179 DESIGN AND PERFORMANCE OF A RAPID-SCANNING X-RAY DIFFRACTOMETER. A.Skertchly.

J. sci. Instrum., Vol. 37, No. 1, 6-14 (Jan., 1960).

The apparatus described enables the equatorial X-ray diffraction intensity distribution from radially symmetrical specimens to be obtained over the angle range 0 to 20° of Bragg θ in twenty seconds. Sequential scans are performed at the rate of two per minute and the X-ray intelligence is retained in the form of pulses by being recorded on magnetic tape which preserves the record with a high degree of fidelity. Also incorporated is an intensity analyser which enables the integrated count to be obtained between any two preset positions of Bragg θ, the limits being adjustable in steps of 0.1° to a high degree of precision. Although the instrument is designed primarily for the investigation of reaction kinetics in certain high polymeric substances of interest to the textile industry, there is obvious scope in other applications which involve relatively rapid changes in lattice parameters. Design details and some performance data are briefly mentioned together with an illustrative application.

539.2 : 548.7

8180 TWIN-HEAD GONIOMETER FOR THE STUDY OF DIFFUSELY REFLECTED X-RAYS.

W.A.Wooster and G.A.Wooster

J. sci. Instrum., Vol. 37, No. 2, 64-6 (Feb., 1960).

The apparatus described is a modified commercial single-crystal X-ray goniometer. Two goniometer heads are mounted on the vertical axis of the instrument so that two crystals may be placed alternately in the X-ray beam. The recording photographic film moves with the crystals and two records of diffuse reflections, one a standard and the other the unknown, are obtained on the same film and with a known ratio of their exposure times. Thermal diffuse scattering from one (standard) crystal is used to determine the intensity of the incident X-ray beam. The thermal or structural X-ray reflection from the second crystal may then be found in absolute measure.

539.2 : 548.7

8181 LOW-ANGLE GEIGER DIFFRACTOMETER FOR USE WITH MONOCHROMATIC RADIATION. P.W.Teare.

J. sci. Instrum., Vol. 37, No. 4, 132-4 (April, 1960).

An X-ray diffractometer has been designed to study low-angle scattering from precipitation-hardening aluminium alloys. The special problems of design that arise with this type of instrument are discussed, and their practical solution illustrated by the low-angle diffractometer finally built. The performance of the diffractometer is critically reviewed and a table of results quoted to show the reproducibility obtainable. It is thought possible that proportional counting could greatly improve the diffractometer.

539.2 : 548.7

8182 UNIDIRECTIONAL INTEGRATING MECHANISM FOR THE BUERGER PRECESSION CAMERA.

E.C Lingafelter and J.M.Stewart.

Rev. sci. Instrum., Vol. 31, No. 4, 399-400 (April, 1960).

The construction of a unidirectional integrating precession camera is described. The camera is a modification of a Buerger—Supper precession camera. It is designed to be used in conjunction with an integrating microphotometer. The instrument has been used to gather zero-level data. Its reliability has been tested by measuring the intensity of the diffracted beams from a single crystal of sodium chloride. The results of the test show good agreement between single crystal data from the precession method and powder data from a spectrometer.

539.2 : 548.7

8183 NEW METHOD FOR INCREASING THE X-RAY REFLECTION POWER OF LITHIUM FLUORIDE CRYSTALS.

E.F.Priestley.

Brit. J. appl. Phys., Vol. 10, No. 3, 141-2 (March, 1959).

Bending and quenching methods for increasing the dislocation density and hence the X-ray reflection power of lithium fluoride have been found ineffective when applied to certain crystals of British origin. An ultrasonic treatment is described which, with abrasion of the surface, gave a gain in reflection intensity of up to $3\frac{1}{2}$ times at 2.0 A and 7 times at 0.6 A.

539.2 : 54

8184 X-RAY DIFFRACTION BY SINGLE CRYSTALS AT LC TEMPERATURES: A CRYOSTAT FOR USE WITH LIQUID HYDROGEN. J.H.Robertson.

J. sci. Instrum., Vol. 37, No. 2, 41-5 (Feb., 1960).

Techniques for cooling a single crystal in X-ray work are discussed, and the merits of the continuous gas-stream method ar noted. It is shown that hydrogen gas has properties which render especially suitable for use in this way. A simple modification of usual method for generating the cold gas stream is described. Th apparatus is capable of maintaining a crystal at a temperature of about 23° K (using hydrogen) for periods up to 48 hr, without interference with the operation of standard diffraction techniques.

539.2 : 54

8185 VACUUM FURNACE FOR HIGH TEMPERATURE X-R DIFFRACTOMETRY. J.N.Van Niekerk.

J. sci. Instrum., Vol. 37, No. 5, 172-5 (May, 1960).

A vacuum furnace, to be used in conjunction with an X-ray diffractometer, for studying phase changes and solid state reactio at high temperatures, is described The sample is heated, primar by radiation, from a platinum/20% rhodium heating element. The present temperature range is from room temperature to 1200° C, a slight modification to the sample holder should allow temperatu of about 1600° C to be reached. Cooling of the furnace jacket is so efficient that simple O-ring principles are used to obtain the desi vacuum conditions. The sample holder is controlled from the outside and can be removed without in any way disturbing the rest of the furnace components. Data on temperature calibration and the experimentally determined inversion temperatures of quartz and iron are given. Decomposition studies of potassium and silver permaganates and phase changes in the iron carbide system, which are now in progress, illustrate the type of investigations which ca be undertaken with this instrument.

539.2 : 548.7 : 535

8186 IMPROVED EYE-PIECE GRATICULE FOR MEASURI X-RAY POWDER DIFFRACTION PATTERNS.

W.G.Perdok and G.Boom.

J. sci. Instrum., Vol. 37, No. 4, 134-5 (April, 1960).

The accuracy of measuring Debye—Scherrer lines can be improved by a slight modification of the cross-wire system in the microscope. The new graticule can be made simply by photograph a large-scale drawing.

539.2 : 548

8187 COUNTER DIFFRACTOMETER — THE THEORY OF THE USE OF CENTROIDS OF DIFFRACTION PROFIL FOR HIGH ACCURACY IN THE MEASUREMENT OF DIFFRACTIO ANGLES. E.R.Pike and A.J.C.Wilson.

Brit. J. appl. Phys., Vol. 10, No. 2, 57-68 (Feb., 1959).

The high resolution of the diffractometer, together with its ability to measure intensities accurately, allows the whole profile of the diffraction lines to be studied. The width of the profiles is dependent on the spectral width of the characteristic radiation and on the geometry of the instrument. It is shown theoretically that the true Bragg angles can only be found, for work of the highest accuracy, from the centroids (first moments) of the profiles, the mathematics required to correct the peak positions being prohibit Experimental procedures required to put this theoretical advantag of the centroid into practice are explained, and difficulties due to the slow decay of the tails of the lines, and the uncertainty of background level are circumvented. An expression for the uncertainty in the centroid, found by step-by-step scanning by the fixed-time technique, due to counting statistics, is derived. This is plotted fo the case of a single Cauchy profile. It is found that this uncertain depends greatly on the peak-to-background ratio, and hence that scintillation or proportional counters have a marked advantage ov Geiger counters for this type of work. It is concluded that, when maximum accuracy in lattice-spacing measurements is desired, t centroid must be used instead of the peak, and that this does not involve excessive inconvenience in practice.

539.2 : 548

8188 MEASUREMENTS OF SLIGHT VARIATIONS OF PARA METERS OR OF LINE-WIDTH BY ACHROMATIC DIAGRAMS. R.Chaulet, A.Guinier and F.Sebilleau.

Acta cryst., Vol. 13, Pt 4, 332-9 (April, 1960). In French.

The final cause of broadening of the Bragg reflection after the elimination of all geometrical effects is the spectral width of the characteristic line. It is suppressed by achromatization. This vice is applied to the study of the back reflections of a single ystal. Slight variations of the parameter or of the width of the line e detected more accurately than with the classical methods.

539.2 : 548.7

8189 A NEW PRECISION METHOD OF MEASURING THE WIDTH OF THE LINES OBTAINED IN THE X-RAY IFFRACTION FROM CRYSTALLITES.

Trompette, H.J.Latière and O.Balique.
R. Acad. Sci. (Paris), Vol. 250, No. 6, 1022-4 (Feb. 8, 1960). French.

A relation between the crystallite size and diffraction line dth is established and a new definition of the line width as the gular distance between the points of inflexion in the line profile used giving certain advantages. Either film or direct recording an be used. A.L.Mackay

539.2 : 548.7

8190 SMEARING AND THE REMOVAL OF SMEARING EFFECTS IN X-RAY SMALL-ANGLE DIAGRAMS.

.Kratky, G.Porod and Z.Skala.
cta phys. Austriaca, Vol. 13, No. 1, 76-128 (1960). In German.

The smearing effects of the slit height and the slit width of the cident beam are considered separately. Methods of correction, ther than the Fourier-analysis method (which is considered too edious here) are described. The effect of partial crystal orientation the specimen is considered. Some graphical methods and mechancal aids are described. A.R.Stokes

539.2 : 548.7

8191 ANALYSIS OF COMPOSITE X-RAY DIFFRACTION PROFILES. J.J.Slade,Jr. and L.F.Nanni.

. appl. Phys., Vol. 31, No. 4, 699-706 (April, 1960).

The irregular line profiles associated with crystals that have a andom structure which is coarse relative to the irradiated area are egarded as the result of the composition of a characteristic distriution and a set of broadening and translating processes. The inverion of this composition is expressed operationally. A differential perator associated with the transform of the intrinsic distribution is ntroduced. This operator reduces the line profile to the set of broadning and translating elements. The operations are such as may be erformed by an analogue computer. Preliminary experiments show at it may be possible to obtain the desired resolution. The effects f "noise" and distortion are investigated.

539.2 : 548.7

8192 THE INFLUENCE OF SURFACE RELIEF ON THE INTENSITY OF X-RAY DIFFRACTION MAXIMA.

A.S.Kagan, B.T.Polyak and S.Sh.Shil'shtein.
Zh. tekh. Fiz., Vol. 29, No. 9, 1142-5 (Sept., 1959). In Russian. English translation in: Soviet Physics—Technical Physics (New York), Vol. 4, No. 9, 1043-5 (March, 1960).

It is shown that in the case of powdered samples with large μR, the intensities of diffraction maxima with low coefficients of reflection are weak compared with the theoretical values. An absorption factor is found, depending on the surface geometry, which gives satisfactory agreement with experiment.

539.2 : 548.7

8193 THE ENERGY FLOW OF X-RAYS IN AN IDEALLY PERFECT CRYSTAL: COMPARISON BETWEEN THEORY AND EXPERIMENTS. N.Kato.

Acta cryst., Vol. 13, Pt 4, 349-56 (April, 1960).

A theory of X-ray energy flow in an ideally perfect crystal is developed based upon the ordinary dynamical theory of diffraction in a more practical form. The following topics are discussed: the spatial intensity profile of a reflected and transmitted beam, and Brown's experiments on the behaviour of a transmitted beam which satisfies the Bragg condition. Agreement between theory and experiment is fairly good. It is pointed out that an intensity enhancement at the margins of a diffracted beam can be explained in terms of a diffraction effect.

539.2 : 548.7

8194 MULTI-PHONON PROCESSES IN SLOW NEUTRON [INCOHERENT] SCATTERING BY CRYSTALS.

A.Sjölander.
Ark. Fys., Vol. 14, Paper 21, 315-71 (1958).

The processes are discussed assuming the harmonic approximation for the crystal vibrations. The differential scattering cross-section is expanded in Hermite orthogonal functions and approximate expressions for the cross-section are derived. Extensive numerical calculations were carried out to illustrate the accuracy of the approximations made. An approximation for the total cross-section (the mass-ratio expansion) suggested by Placzek (Abstr. 5341 of 1952; 6014 of 1954; 4788 of 1957) is discussed and in some respects generalized. The approximations for the differential cross-section are also used to derive approximate formulae for the total cross-section valid for cold neutrons, but arbitrary temperatures and mass ratios.

539.2 : 548.7

8195 DIFFUSE SCATTERING OF X-RAYS BY THERMAL AGITATION AND THE COMPTON EFFECT IN FLUORITE (CaF_2). D.Cribier.

Ann. Phys. (Paris), Ser. 13, Vol. 4, No. 3-4, 333-83 (March-April, 1959). In French.

A simplified interatomic field is proposed for the CaF_2 crystal. The intensity distribution of X-rays scattered by a CaF_2 crystal was measured in a vacuum spectrometer with an ionization chamber and Geiger counter. The intensity of thermal scattering was calculated and the Compton scattering was thus obtained from the measurements. J.Franks

539.2 : 548.7 : 539.18

8196 A STUDY OF THE COMPTON SCATTERING OF X-RAYS. II. Li, Li^+, Be, Na, Na^+, Al^+, Al^{+3}, K^+, Cl^-, Ca, Ca^+ AND Ca^{+2}. A.J.Freeman.

Acta cryst., Vol. 13, Pt 3, 190-6 (March, 1960).

Following the methods of a previous paper (Abstr. 4620 of 1960) the Compton incoherent scattering functions were calculated using Hartree—Fock selfconsistent-field wave-functions. As was found earlier, the exchange terms in the Waller—Hartree expression are of considerable importance for obtaining accurate values of the incoherent scattering intensities. Comparison is made with earlier calculations and with the experiments of Laval on KCl, and Cribier on CaF_2.

539.2 : 548.7 : 539.18

8197 ATOMIC SCATTERING FACTOR FOR O^{2-}. T.Suzuki.

Acta cryst., Vol. 13, Pt 3, 279 (March, 1960).

539.2 : 548.7

8198 ON THE TAYLOR SERIES APPROXIMATION OF ΔF. H.A.R.Wegener.

Acta cryst., Vol. 13, Pt 3, 186-9 (March, 1960).

One contributing factor for the necessity of damping factors to insure convergence in the least-squares analysis of crystal structure parameters is the neglect of higher order derivatives in the Taylor series approximation for ΔF. It is shown here how a second derivative term can be introduced into the general framework of the procedure without requiring a major change in existing computation programmes.

539.2 : 548.7

8199 VECTOR SPACE AND ITS APPLICATION IN CRYSTAL STRUCTURE INVESTIGATION. M.J.Buerger.

New York : John Wiley (1959) xiv + 247 pp., illus.

This book is reviewed in Acta Cryst., Vol. 13, Pt 3, 280 (March, 1960).

539.2 : 548.7

8200 CRYSTALLOGRAPHIC CALCULATIONS USING AN ELECTRONIC DIGITAL COMPUTER. I. CALCULATION OF PATTERSON AND ELECTRON DENSITY FUNCTIONS.

S.Westman,G.Blomqvist and S.Åsbrink.
Ark. Kemi, Vol. 14, Paper 49, 535-44 (1959).

A programme for the calculation of three-dimensional Fourier and Patterson syntheses, sections, projections and bounded projections has been constructed for the electronic computer B.E.S.K. The possibility of calculating the Patterson or electron density function inside small "boxes" in space is stressed. The shceme of the calculations could easily be used with any digital computer.

539.2 : 548.7

8201 CRYSTALLOGRAPHIC CALCULATIONS USING AN ELECTRONIC DIGITAL COMPUTER. II. CALCULATION OF STRUCTURE FACTORS.

S.Åsbrink, G.Blomqvist and S.Westman.
Ark. Kemi, Vol. 14, Paper 50. 545-52 (1959).

A programme has been constructed for the automatic calculation of structure factors of centrosymmetric (F(hkl)) and non-centrosymmetric (|F(hkl)| and α (hkl)) structures. The number of atoms in the unit cell must not exceed 127 (in the centrosymmetric case 254) and the number of atomic species must not be larger than 12. The calculations can be made on any reflection (hkl) with the following limitation: $-127 \leq h,k,l \leq 127$. The structure factors are obtained grouped in one of three alternate ways corresponding to the three ways for grouping the structure factor data in the programme for the calculation of the electron density function (see preceding abstract). The possibility of calculation with individual isotropic temperature factors is emphasized. A further enlargement of the programme in order to make possible the use of anisotropic temperature factors is planned. The principles employed in this work should be applicable also to other digital computers than the present one (B.E.S.K.).

539.2 : 548.7

8202 CRYSTALLOGRAPHIC PROGRAMMES FOR A COMPUTER. J.C.Gower and J.H.Rayner.

Brit. J. appl. Phys., Vol. 9, No. 11, 446-7 (Nov., 1958).

A brief description is given of programmes developed for the calculations involved in the X-ray analysis of crystal structures. The programmes calculate three dimensional structure factors, one and two dimensional Fourier syntheses and R-factors.

539.2 : 548.7 : 519

8203 TO FIT A PLANE TO A SET OF POINTS BY LEAST SQUARES. D.M.Blow.

Acta cryst., Vol. 13, Pt 2, 168 (Feb., 1960).

See Abstr. 13917 (1959). A rapid method is proposed, based on the solution of an equation by successive approximations.

A.R.Stokes

539.2 : 548.7

8204 DIFFUSE STREAKS IN THE DIFFRACTION PATTERN OF VANADIUM SINGLE CRYSTALS.

E.Sándor and W.A.Wooster.

Acta cryst., Vol. 13, Pt 4 339-48 (April 1960).

Diffuse streaks observed in the diffraction pattern of 99.6% pure vanadium single crystals have been identified as the diffraction pattern of a separate hexagonal phase, which consists of vanadium atoms in hexagonal close packing with nitrogen atoms in octahedral holes. The hexagonal lattice parameters are $a = 2.88 \pm 0.01$, $c = 4.55_5 \pm 0.01$ A, $c/a = 1.58 \pm 0.01$. In most specimens the hexagonal phase has 12 equally probable different orientations relative to the b.c.c. vanadium matrix. The lattice relations of the two phases can be described as follows:

$$(00.1)_{c.p.h.} \,||\, \{110\}_{b.c.c.} \text{ and } [100]_{c.p.h.} \,||\, [111]_{b.c.c.}$$

i.e. the most densely populated planes of the two phases and one of their most densely populated rows coincide. One particular vanadium crystal has been found in which the hexagonal lattice has 24 different orientations. Possible explanations of the observed lattice relations are discussed.

539.2 : 548.7

8205 THE ELECTRON DENSITY DISTRIBUTION IN AMMONIUM BIFLUORIDE. T.R.R.McDonald.

Acta cryst., Vol. 13, Pt 2, 113-24 (Feb., 1960).

A three-dimensional X-ray analysis of NH_4HF_2 was made, based upon Geiger-counter measurements of intensity. The electron density was measured with a s.d. varying from 0.06 e.A^{-3} in general positions to 0.11 e.A^{-3} in special positions. It is found that the electron density distribution in the H atoms of the NH_4^+ ion corresponds closely to that in an isolated atom with a temperature factor of $\exp(-2.4 \sin^2 \theta/\lambda^2)$. The electron density in the H atoms of the $(FHF)^-$ ions is subject to a rather larger random error, and the results are less clear cut. These atoms have a low peak density (0.47 and 0.52 e.A^{-3}) but the electron count (average) over a sphere of radius 1.1 A is normal. There is thus no evidence for a transfer of charge from H to F. The averaged electron density in these two atoms has spherical symmetry, within rather wide limits of error. The F atoms have strongly anisotropic vibrations, and their electron distributions appear to be more diffuse than that in an isolated atom. Attempts to determine the state of ionization of the N and F atoms were not conclusive. The two independent F—H—F bond distances are 2.275 and 2.269 A (s.d. 0.005 A), and the N—H distances are both 0.88 A (s.d. 0.03 A) which is significantly less than the inter-nuclear distance of 1.025 A.

539.2 : 548.7

8206 THE STRUCTURE OF ICE. K.Lonsdale.

Proc. Roy. Soc. A, Vol. 247, 424-34 (Oct. 21, 1958).

A consistent set of unit cell parameters at various temperatu is not yet available for ordinary ice, but the mean of the most precise measurements leads to a density of 0.9164 g/cm^3 at 0°C (atmospheric pressure) with a cubical expansion coefficient of 11×10^{-5}, increasing to 0.9414 and 21×10^{-5} at liquid air tempera tures. Corresponding figures for heavy ice are 1.0172 g/cm^3 and 12×10^{-5} at 0°C, 1.0449 and 18×10^{-5} at −180°C. The hydrogen-bond lengths are not significantly different for ordinary and heavy ice, but in both cases the mirror-symmetric bond (along the princ axis) is about 0.01 A shorter than the centro-symmetric bond at 0° At low temperatures the bond lengths tend to equalize at a value some 1% lower than at 0°C. The hexagonal (tridymite-type) and cubic (cristobalite-type) forms of ice have approximately the same density and hydrogen-bond lengths at −130°C, and both appear to have a statistical randomness of the water-molecule orientation, consistent with there being one hydrogen only (nearly or exactly) along each bond. The thermal vibrations of the hydrogen atoms in hexagonal ice are anisotropic, those of the oxygen atoms nearly spherical. The ranges of stability of hexagonal cubic and amorpho ice are not exactly known, but cubic ice is only formed at low rates of deposition, low pressures and at temperatures of about −80 to −140°C.

539.2 : 548

8207 STRUCTURE OF PRECIPITATED CADMIUM SULPHID AS STUDIED BY SINGLE-CRYSTAL ELECTRON DIFFRACTION PATTERN. R.Sato.

Nature (London), Vol. 184, 2005-6 (Dec. 26, 1959).

Cubic β-form and hexagonal α-form of cadmium sulphide have been precipitated on a cleavage face of galena respectively from cadmium nitrate and cadmium chloride solutions. A series of experiments indicated that the structure of precipitated CdS is not governed by the initial nuclei on which it crystallizes but by the cadmium salt used. Under suitable conditions a hybrid form may be produced. Relative orientations of the precipitated crystals and galena were determined.

J.Ada

539.2 : 548.

8208 THE STRUCTURE OF THE INTERMETALLIC PHASE θ(Cr—Al). M.J.Cooper.

Acta cryst., Vol. 13, Pt 3, 257-63 (March, 1960).

The monoclinic θ-phase in the chromium—aluminium system has been shown to be isomorphous with α'(V—Al). The structure was refined and the interatomic distances are discussed and compared with those in α'(V—Al) and with those in two ternary alloy phases containing chromium and aluminium.

539.2 : 548.

8209 AN ELECTRON DIFFRACTION STUDY OF THE EFFEC OF HEAT TREATMENT ON α-Fe_2O_3 (HAEMATITE) SINGLE CRYSTALS. M.Blackman and G.Kaye.

Proc. Phys. Soc., Vol. 75, Pt 3, 364-8 (March, 1960).

Electron diffraction patterns were taken from a large variety o natural single crystals of α-Fe_2O_3 (haematite) which had previously been heated to 500°C. Some of these showed additional patterns similar to those observed by Finch and Sinha [Proc. Roy. Soc. A, Vol. 241, 1-8 (July 23, 1957)]. Measurements of the basic plane spacings associated with the extra patterns showed that these differed considerably from the corresponding basic plane spacings of α-Fe_2O_3. This result is in contradiction to the findings of Finch an Sinha who claimed that the basic plane spacings associated with the extra patterns approximated closely to those of α-Fe_2O_3. There is therefore no justification for assuming that a new form of Fe_2O_3 (β-Fe_2O_3) exists. Experiments were also carried out on crystals o α-Fe_2O_3 which had been heated to temperatures between 700° and 1000°C. In some cases oriented layers of Fe_3O_4 (magnetite) were observed but no evidence was found for the presence of γ-Fe_2O_3 (maghemite) in contrast to the results of Finch and Sinha. These investigators claimed that γ-Fe_2O_3 was formed when α-Fe_2O_3 cryst were heated in air to temperatures above 700°C.

539.2 : 548

8210 MANGANESE DIBORIDE. I.Binder and B.Post.

Acta cryst., Vol. 13, Pt 4, 356 (April, 1960).

The preparation of the crystals is described. MnB_2 has the AlB_2 type structure; it is isomorphous with TiB_2, VB_2, CrB_2, and other transition metal diborides. The unit cell is hexagonal with a = 3.037 A, and c = 3.037 A, both ± 0.002 A. Powder diffraction data are listed.

539.2 : 548.7

8211 CRYSTAL STRUCTURE OF Nb_3Be_2.

A.Zalkin, D.E.Sands and O.H.Krikorian.

Acta cryst., Vol. 13, Pt 2, 160 (Feb., 1960).

A single crystal was examined by the Weissenberg method. The cell is tetragonal with a = 6.49 ± 0.01, c = 3.35 ± 0.01 A, c/a = 0.517. The structure is isomorphous with U_3Si_2; the space group is P4/mbm with two formula units per unit cell. Thirty-one hk0 intensities were measured with Mo K α radiation; refinement of the proposed structure by the least-squares method yielded a reliability factor of 2.93%. The atomic positions and interatomic distances are given.

539.2 : 548.7

8212 THE CRYSTAL STRUCTURE OF KGe AND ISOMORPHOUS GERMANIDES AND SILICIDES.

E.Busmann.

Naturwissenschaften, Vol. 47, No. 4, 82 (1960). In German.

KGe is cubic, space-group $P\bar{4}3n$, a = 12.8 A; unit cell contains $K_{32}Ge_{32}$. Atomic coordinates are given. A.R.Stokes

539.2 : 548.7

8213 X-RAY CRYSTALLOGRAPHIC INVESTIGATION OF MECHANICALLY AND THERMALLY WORKED (100) FACES OF ROCKSALT.

F.Asselmeyer and W.Bienert.

Z. angew. Phys., Vol. 12, No. 1, 16-26 (Jan., 1960). In German.

X-ray reflection curves were recorded showing the effects of cold-working, polishing, and heat-treatment up to 750°K.

A.R.Stokes

539.2 : 548.7

8214 CRYSTALLOGRAPHIC EVIDENCE FOR A SUPERSTRUCTURE IN GERMAN-SILVER ALLOYS.

D.Bialas, R.Hosemann, A.Kussmann, F.Motzkus and H.Wollenberger.

Naturwissenschaften, Vol. 47, No. 4, 81-2 (1960). In German.

Debye—Scherrer photographs, taken with precautions to reduce background to a minimum, showed superlattice lines. The kinetics of ordering were followed by magnetic observations. A.R.Stokes

539.2 : 548.7

8215 THE CRYSTAL STRUCTURES OF $BaZnO_2$, $BaCoO_2$ AND $BaMnO_2$.

U.Spitsbergen.

Acta cryst., Vol. 13, Pt 3, 197-8 (March, 1960).

Alkali-earth oxides and bivalent transition-metal oxides will form compounds ABO_2 when the alkali-earth ion is large and the transition-metal ion is small. In the investigation of the systems Ba—M—O, in which M represents Mn, Co, Ni, Zn and Be, a similarity between the powder diagrams of the compounds $BaCoO_2$, $BaMnO_2$ and the compound $BaZnO_2$ was found. A crystallographic analysis was made on a powder diagram of $BaZnO_2$, which results in a model in which the Zn and O ions are arranges in a distorted high (β -) quartz structure, while the Ba ions filled up the widened holes between the O tetrahedra. This behaviour of the alkali earth metal in $BaZnO_2$ can be compared with that of the alkali metal in $KFeO_2$.

539.2 : 548.7

8216 ON TETRAGONALIZATION OF THE SPINEL STRUCTURE OF Co Mn MIXED OXIDES.

I.Aoki and Y.Fukunaga.

J. Coll. Arts Sci. Chiba Univ., Vol. 2, No. 3, 271-4 (March 1959).

On the tetragonal symmetry distortion of spinels, such as Mn_3O_4, $ZnMn_2O_4$ and $CuFe_2O_4$, Goodenough and Loeb (Abstr. 6604 of 1955) have reported that Mn^{3+} or Cu^{2+} ions in octahedral site have a tendency to form dsp^2 bonds, which is attributed to the difference in length between four covalent and two ionic bonds. Furthermore, Finch, Sinha and Sinha [Proc. Roy. Soc. A, Vol. 242, 28 (Oct. 15, 1957)] considering these elongated octahedra in octahedral sites to be aligned parallel to each other in a certain direction as the number of them increase, have given an account of the ferrites Mn_3O_4 and $CuFe_2O_4$ in terms of the Bragg-Williams order-disorder theory of alloys and Weiss molecular field theory of ferromagnetism. In this paper, the Co-Mn mixed oxides are treated using the theory of Finch, Sinha and Sinha, supported by a study of the critical temperatures.

539.2 : 548.7 : 537.2

8217 THE RELATION BETWEEN STRUCTURE AND FERROELECTRICITY IN LEAD BARIUM AND BARIUM STRONTIUM NIOBATES.

M.H.Francombe.

Acta cryst., Vol. 13, Pt 2, 131-40 (Feb., 1960).

X-ray crystallographic studies were made of barium metaniobate, $BaNb_2O_6$, and of the ferroelectric solid solution series $(Pb,Ba)Nb_2O_6$ and $(Ba,Sr)Nb_2O_6$.$BaNb_2O_6$ possesses two polymorphic structures—a hexagonal form stable within a narrow temperature range below the melting point, 1450°C, and an orthorhombic form stable at lower temperatures. The single-phase $(Pb,Ba)Nb_2O_6$ and $(Ba,Sr)Nb_2O_6$ solid solutions have structures which, like the ferroelectric phase of $PbNb_2O_6$, are closely related to that of the tetragonal tungsten bronzes, e.g. $K_{0.57}WO_3$. In the compounds $(Pb_{1-x}Ba_x)Nb_2O_6$ with $x < 0.4$ the polar axis lies in the direction of one of the $\langle 110 \rangle$ axes of the related tetragonal structure, and in the ferroelectric phase this produces a slight orthorhombic distortion. High-temperature X-ray studies suggest that as x exceeds 0.5 the polar axis switches to the unique, short [001] axis of the structure. These ferroelectric strain effects have been attributed to the perovskite-like groups of atoms which form a part of the true repeat unit of the structure. Materials in the range $0.375 < x < 0.475$ comprise both orthorhombic and tetragonal ferroelectric phases, characterized for each composition by a common Curie point. The properties of the system $(Ba_{1-x}Sr_x)Nb_2O_6$ are broadly similar to those of the $(Pb,Ba)Nb_2O_6$ series, but, except at the Ba-rich end of the system, i.e., $x < 0.2$, the Curie points are generally low, and the ferroelectric strain effects are small.

539.2 : 548.7 : 537.2

8218 X-RAY, DIELECTRIC, AND OPTICAL STUDY OF FERROELECTRIC LEAD METATANTALATE AND RELATED COMPOUNDS.

E.C.Subbarao, G.Shirane and F.Jona.

Acta cryst., Vol. 13, Pt 3, 226-31 (March, 1960).

Single crystals of ferroelectric lead metatantalate, $PbTa_2O_6$, were grown using $Pb_2V_2O_7$ as a flux. An X-ray and optical study shows that $PbTa_2O_6$ has orthorhombic symmetry with $a_0 = 17.68$, $c_0 = 7.754$ A, $b_0/a_0 = 1.002$ at room temperature. The ferroelectric axis is perpendicular to the [001] direction. Dielectric constant and birefringence along the three directions were measured as a function of temperature through the Curie point at 265° C. The crystals remain orthorhombic in the paraelectric region. A dielectric and X-ray study of the solid solution systems $Pb(Ta,Nb)_2O_6$, $(Pb,Ba)Nb_2O_6$, and $(Pb,Sr)Ta_2O_6$ shows the existence of a phase boundary in the first two systems, separating different ferroelectric modifications. Besides the ferroelectric modification, $PbTa_2O_6$ has a non-ferroelectric, rhombohedral form.

539.2 : 548.7

8219 REFINEMENT OF THE STRUCTURE OF $LiMnPO_4$.

S.Geller and J.L.Durand.

Acta cryst., Vol. 13, Pt 4, 325-31 (April, 1960).

The least-squares technique applied to three-dimensional X-ray diffraction data was used to refine the structure of $LiMnPO_4$. The crystal belongs to space group D_{2h}^{16}-Pmnb; the unit cell with a = 6.10 ± 0.02, b = 10.46 ± 0.03, c = 4.744 ± 0.010 A, contains four formula units. The structure is closely related to that of olivine (Mg_2SiO_4). It consists of discrete PO_4 tetrahedral complexes and highly distorted oxygen octahedra about the Li^+ and Mn^{2+} ions. The average P—O distance is 1.54 A with no significant differences among the three nonequivalent P—O distances. The PO_4 tetrahedron is not regular, however, there being two significantly different sets of O—O distances or O—P--O angles. For this structure, neglect of off-diagonal terms of the normal equations matrix of the least-squares calculation does not significantly affect the results. Furthermore the least-squares calculation with use of only the [001], [010], and [100] zonal data and neglect of the off-diagonal terms of the normal equations matrix gives results differing in only a minor way from those obtained by use of three-dimensional data and inclusion of the off-diagonal terms of the normal equations matrix.

539.2 : 548.7 : 535

UNIT CELL PARAMETERS OF Ni NITRATE HEXAHYDRATE.

See Abstr. 7991

539.2 : 548.7

8220 CRYSTALLOGRAPHIC DATA FOR POTASSIUM MANGANATE K_2MnO_4.

F.H.Herbstein.

Acta cryst., Vol. 13, Pt 4, 357 (April, 1960).

Oscillation and Weissenberg photographs showed the crystals to be orthorhombic with cell dimensions: a = 7.66 ± 0.01, b = 10.33 ± ± 0.01, c = 5.89 ± 0.01 A. The calculated density for four K_2MnO_4 molecules per cell is 2.81 g cm^{-3}, close to that of $KMnO_4$ (2.70 g cm^{-3}). The possible space groups are C_{2v}^{9} —Pna and D_{2h}^{16} —Pnam; the latter is preferred because of the isomorphism of K_2MnO_4 and low K_2SO_4. Powder diffraction data are given.

539.2 : 548.7

8221 THE CRYSTAL STRUCTURE AND LATTICE PARAMETERS OF SOME RARE EARTH MONO-SELENO OXIDES.

H.A.Eick.

Acta cryst., Vol. 13, Pt 2, 161 (Feb., 1960).

The rare earth mono-seleno oxides are isostructural with the corresponding mono-thio oxides. The space group is $D_{3d}^3-P\bar{3}m$, and the unit cell, which contains one molecule, has a selenium atom at (0,0,0), two metal atoms at $\pm(\frac{1}{3},\frac{2}{3},z_1)$, where $z_1 = 0.29$, and two oxygen atoms at $\pm(\frac{1}{3},\frac{2}{3},z_2)$, where $z_2 \cong 0.62$. The value of z_1 is probably accurate to within ±0.01. The observed and calculated d values and relative intensities of La_2O_2Se are tabulated. Some interatomic distances are La-O, 2.42 A; O-O, 2.90 A; and La-Se, 3.08 A. Lattice parameters and calculated densities are tabulated for M_2O_2Se, where M = La, Pr, Nd, Sm, Gd, Ho, Er, Yb.

539.2 : 548.7

8222 THE CRYSTAL STRUCTURE OF SODIUM TRIPHOSPHATE, $Na_5P_3O_{10}$, PHASE II.

D.R.Davies and D.E.C.Corbridge.

Acta cryst., Vol. 11, Pt 5, 315-19 (May, 1958).

539.2 : 548.7

8223 THE CRYSTAL STRUCTURE OF SODIUM TRIPHOSPHATE, $Na_5P_3O_{10}$, PHASE I. D.E.C.Corbridge.

Acta cryst., Vol. 13, Pt 3, 263-9 (March, 1960).

The crystal structure of the high-temperature form of sodium triphosphate, $Na_5P_3O_{10}$, Phase I, was determined by Fourier methods. The unit cell is monoclinic with a = 9.61, b = 5.34, c = 19.73 A; β = 112°. The space group is C2/c and the unit cell contains 4 units of $Na_5P_3O_{10}$. The triphosphate ions have twofold axial symmetry with the central phosphorus atoms lying on twofold axes of the unit cell. Bond lengths are P—O (chain) = 1.62 ± 0.03 (outer), P—O (mean, terminal) 1.48 ± 0.03 A. The structure is generally more distorted than that found previously for the low-temperature form, Phase II. Some of the sodium ions are co-ordinated in distorted octahedral arrangements while the remainder are involved in 4-fold co-ordination of an unusual type. A comparison of the structures of Phase I and Phase II suggests an explanation of some of their differences in properties.

539.2 : 548.7

8224 THE CRYSTAL STRUCTURE OF $ZnSnAs_2$.

O.G.Folberth and H.Pfister.

Acta cryst., Vol. 13, Pt 3, 199-201 (March, 1960). In German.

Unlike the other $A^{ii}B^{iv}C_2^{v}$ compounds, $ZnSnAs_2$ does not crystallize in the chalcopyrites type ($E1_1$) but has a zinc blende structure (a = 5.851 ± 0.001 A) with a random distribution of Zn and Sn among the metal sites. An explanation of this difference of type is seen in the greater similarity of the polarizability of the Zn—As and the Sn—As bond than of the bonds in the other $A^{ii}B^{iv}C_2^{v}$ compounds.

539.2 : 548.7

8225 THE CRYSTAL STRUCTURE OF CELSIAN (BARIUM FELSPAR). R.E.Newnham and H.D.Megaw.

Acta cryst., Vol. 13, Pt 4, 303-12 (April, 1960).

Celsian, $BaAl_2Si_2O_8$, is a felspar with a 14 A c-axis and a body-centred lattice. The structure was determined by X-ray analysis, using Fourier difference maps and least-squares methods. The atomic parameters were obtained as the sum of average parameters, appropriate to a 7 A structure and derived from the main (a-type) reflections, and difference parameters, with opposite signs in the two sub-cells, derived from the difference (b-type) reflections. The structure shows a good approximation to an ordered arrangement with alternating Si and Al atoms. The Ba atom occupies identical positions in the two sub-cells but has an anisotropic "temperature" factor. Discussion of the structure includes comparison with anorthite ($CaAl_2Si_2O_8$) and with potash felspars, with regard both to the behaviour of the large cation and to the nature of the network, the 14 A repeat being seen as a necessary consequence of the Si,Al alternation.

539.2 : 548.7

8226 NEW SYNTHETIC GARNETS.

S.Geller and C.E.Miller with an Appendix by R.G.Treuting.

Acta cryst., Vol. 13, Pt 3, 179-86 (March, 1960).

Twenty-three new synthetic garnets of types: $M^{2+}R_2^{3+}Mn_2Ge_3O_{12}$, $M^{2+}R_2^{3+}M_2^{2+}Ge_3O_{12}$, $R_3^{3+}M_2^{2+}GaGe_2O_{12}$ and $Ca_3M^{4+}M^{2+}Ge_3O_{12}$ are reported. In these formulae, M^{4+} is a tetravalent metal ion of Zr, Sn or Ti; R^{3+} is an yttrium or gadolinium ion; M^{2+} is one of a variety of divalent metal ions, not all of which go into all the types. It is probable that R^{3+} could be almost any trivalent rare earth ion. Three other garnets are reported: $Mn_3NbZnFeGe_2O_{12}$; one of probable formula $Ca_3ZrFeGe_{2.8}O_{12}$, in which Fe has an average valence of 2.9, and $Y_2Mn_2FeGe_{2.8}O_{12}$ in which Fe has an average valence of 2.8. The latter two are defect structures. It is shown quantitatively that t thirds of the Co^{2+} ions in $CoGd_2Co_2Ge_3O_{12}$ and in $CoY_2Co_2Ge_3O_{12}$ occupy octahedral positions, the remaining third occupying the d cahedral positions. The distributions of ions in the other new ga is discussed. To date, the Co^{2+} ion is the only one with non-sphe cal electronic configuration which is definitely known to occupy o hedral positions in the garnets. There are still no known garnets which ions with non-spherical electronic configuration occupy tetr hedral positions. The programming of the calculation of powder intensities including both real and imaginary parts of the dispers corrections on the IBM 704 computer is briefly described in an appendix.

539.2 : 54

8227 CRYSTALLINE STRUCTURE OF METATORBERNITE

E.S.Makarov and K.I.Tobelko.

Dokl. Akad. Nauk SSSR, Vol. 131, No. 1, 87-9 (March-April, 1960

In Russian.

X-ray investigation of metatorbernite, $Cu(UO_2)_2(PO_4)_2.8H_2O$ shows the space group to be P4/nmm with a = 6.95 ± 0.02 A, c = 17.26 ± 0.06 A. The projections of the electron density on the (100) plane, and of the structure on the (100) and (110) planes are given. The pycnometric density is 3.79 g/cm³. R.F.S.Hear

539.2 : 54

8228 A NEUTRON DIFFRACTION STUDY ON THE CRYSTA STRUCTURE OF SULFAMIC ACID. R.L.Sass.

Acta cryst., Vol. 13, Pt 4, 320-4 (April, 1960).

A single-crystal neutron diffraction investigation of NH_2SO_3H was made in which the intensities of 219 reflections in all three prism zones were measured. The structure was refined by Fouri and least-squares techniques. The heavy-atom positions obtained agree quite well with those of Osaki, Tadokoro and Nitta (1955). T hydrogen atom positions found confirm the zwitterion form of the molecule but differ substantially from those postulated from the X-ray work by Osaki et al. (1955). The hydrogen bonding system consists of three single N—H · · · O bonds in which the N—H bond makes angles of 7°, 13°, and 14° with the various N · · · O vectors.

539.2 : 548

8229 RESEARCH ON THE SYSTEM UO_2 - ThO_2 - ZrO_2.

C.Brisi.

Atti Accad. Sci. Torino I, Vol. 94, No. 1, 67-76 (1959-60).

The structure of the various solids obtained by heating togeth in a current of hydrogen, mixtures of UO_2, ZrO_2 and ThO_2 were ex mined by X-rays. The chemical compositions; crystal structures and values of the cubic lattice constant are listed. The limits of solubility for preparations obtained by heating to 1000°C are prac tically the same as those for much higher temperatures.

S.Weintrou

539.2 : 548

8230 THE CRYSTAL AND MOLECULAR STRUCTURE OF PYRIMIDINE. P.J.Wheatley.

Acta cryst., Vol. 13, Pt 2, 80-5 (Feb., 1960).

The structure was determined by a three-dimensional least-squares analysis. The crystals are orthorhombic, $Pna2_1$, with fou molecules in the unit cell. No molecular symmetry is required, a there seems to be a slight but significant departure from the expected mm symmetry. The bond lengths obtained from the X-ray analysis were corrected for the effects of thermal motion which is very important in these simple cyclic molecules. The final R factor is 8.7%.

539.2 : 548

8231 A THREE-DIMENSIONAL ANALYSIS OF THE CRYST STRUCTURE OF p-BENZOQUINONE. J.Trotter.

Acta cryst., Vol. 13, Pt 2, 86-95 (Feb., 1960).

A three-dimensional refinement of the crystal structure of p-benzoquinone has proceeded by computing observed and calculated differential syntheses, and an initial discrepancy factor of 22.5% h been reduced, after one isotropic and four anisotropic cycles, to 12.4%. The thermal motions of the atoms were interpreted in ter of the anisotropic translational and rotational oscillations of the mo cule, and the final molecular dimensions were compared with the results of an electron-diffraction investigation of the vapour, with the dimensions of similar molecules, and with theoretical values.

539.2 : 54

8232 THE CRYSTAL STRUCTURE OF 1,5-DINITRONAPHTHALENE. J.Trotter.

Acta cryst., Vol. 13, Pt 2, 95-9 (Feb., 1960).

The crystals are monoclinic, space group $P2_1/a$, with two mo es in the unit cell. The structure was determined from projec- s along the three principal crystallographic axes, and details of molecular geometry and dimensions were obtained. The nitrogen n and all the carbon atoms lie on one plane, but the planes of the o groups are rotated about the C—N bonds 49° out of the aromatic ne.

539.2 : 548.7

8233 CRYSTAL STRUCTURE OF ETHYL 9-BROMO 10-ANTHRACENE. C.Hauw.

ta cryst., Vol. 13, Pt 2, 100-4 (Feb., 1960). In French.

The structure was determined by means of electron-density ojections of the (001) and (010) planes. The crystal is ortho- ombic; the unit-cell dimensions are: a = 16.78, b = 14.47, c = 5.13 A. e space group is $P2_12_12_1$. The unit cell includes four molecules. e $C_{10}—C_{15}$ (ethyl) bond length is relatively short, whereas the trahedron angle of C_{15} is large (124°).

539.2 : 548 7

8234 DIRECT DETERMINATION OF THE STRUCTURE OF L-CYSTINE DIHYDROBROMIDE.

Peterson, L.K.Steinrauf and L.H.Jensen.
cta cryst., Vol. 13, Pt 2, 104-9 (Feb., 1960).

The structure was determined by a statistical method and re- ned by means of two-dimensional difference syntheses. The unit ell is orthorhombic with a = 17.85, b = 5.35, c = 7.48 A, space roup $P2_122_1$. The precision of the structure was evaluated, and the eneral features compared with those of other structures containing e cystinyl group. A simple solvent saw for cutting the crystals is escribed.

539.2 : 548.7

8235 THE CRYSTAL STRUCTURE OF THE ETHYLENE COMPLEX TRANS-[$Pt(C_2H_4)(NH(CH_3)_2)Cl_2$].

.R.H.Alderman, P.G.Owston and J.M.Rowe.
cta cryst., Vol. 13, Pt 2, 149-55 (Feb., 1960).

The crystals are monoclinic, with the unit-cell parameters = 7.77 ± 0.02, b = 8.67 ± 0.03, c = 6.65 ± 0.02 A; β = 102°. There re two molecules in the unit cell (density observed 2.60, calculated .59 g cm^{-3}), and the space group is $P2_1/m$ or $P2_1$. The [010] and 001] projections were studied, and the positions of the light atoms ound by the systematic use of difference syntheses. The structure so derived has the symmetry of $P2_1/m$, the principal plane of the molecule being a plane of symmetry. It is confirmed that the ethylene molecule is symmetrical bound to the platinum atom. The carbon—carbon bond (1.47 A) is longer than a normal double bond, though the significance to be attached to this lengening depends on the method used to assess the errors. The bond-lengths Pt—Cl (2.30 and 2.33 A) and Pt—N (2.02 A) have normal values within experimental error, in spite of the high trans-effect of the ethylene ligand, and there is no "trans-lengthening" or "cis-shortening" of the bonds. The π-bonding theory of the trans-effect accounts for this result and also for the apparently contradictory observation of Bokii and Kukina (1957) that in the ion [$Pt(C_2H_4)Br_3$]$^-$ the bond lengths differ from their normal values. The standard deviations of the bond-lengths were calculated from the diagonal elements only of the least-squares matrix to be $CH_2—CH_2$ 0.18, Pt—Cl 0.04, Pt—N 0.19 A, but this approximate method of estimating the errors may not be appropriate to this type of compound.

539.2 : 548.7

8236 THE CRYSTAL STRUCTURE OF A COMPLEX HYDRIDE OF PLATINUM, [$Pt((C_2H_5)_3P)_2HBr$].

P.G.Owston, J.M.Partridge and J.M.Rowe.
Acta cryst., Vol. 13, Pt 3, 246-52 (March, 1960).

[$Pt((C_2H_5)_3P)_2HBr$] is orthorhombic, space group $Pn2_1a$; the unit cell has the dimensions a = 14.76 ± 0.04, b = 8.92 ± 0.03, c = 13.87 ± 0.04 A, and contains four molecules (density observed 1.88 g cm^{-3}, calculated 1.86 g cm^{-3}). The [010] and [100] projections were studied, making systematic use of difference syntheses. The molecule has a trans square-planar configuration and is therefore a complex hydride of Pt(II). The Pt—P bonds (2.26 A) are shorter than expected, probably because they have partial double-bond character. The unusual length of the Pt—Br bond (2.56 A) is in accord with the high chemical lability of the coordinated bromide ion. It may be attributed to an electrostatic trans-influence of the hydride ion, or to a cis-influence of the phosphorus atoms operating though the d_{xy}-type orbitals of the metal, or to a combination of these two effects. The positions of the carbon atoms were not found accurately, but they appeared in partial difference maps sufficiently clearly to show that the principal plane of the molecule containing the platinum, bromine and phosphorus atoms is not a plane of symmetry.

539.2 : 548.7

8237 THE CRYSTAL STRUCTURE OF THE BINUCLEAR THIOCYANATE COMPLEX α-[$Pt_2(SCN)_2Cl_2(P(C_3H_7)_3)_2$].

P.G. Owston and J.M. Rowe
Acta cryst., Vol. 13, Pt 3, 253-7 (March, 1960).

α-[$Pt_2(SCN)_2Cl_2(P(C_3H_7)_3)_2$] crystallizes in the monoclinic system space-group $P2_1/n$, with the unit-cell dimensions a = 7.54 ± 0.02, b = 13.62 ± 0.03, c = 15.09 ± 0.03 A; β = 95.0°. The density is 1.937 g cm^{-3}, and there are two molecules in the unit cell (calculated density 1.930 g cm^{-3}); the molecule must therefore have a centre of symmetry. The structure was derived from a study of the [010] and [100] projections. The two platinum atoms were shown to be linked by the two −SCN− groups, each platinum atom being bound to the sulphur atom of one −SCN− group and the nitrogen atom of the other. All the atoms in the molecule, except for those of the six propyl groups, are coplanar, within experimental error. The Pt—P bond length (2.16 A) is very much shorter, and Pt—S (2.44 A) is longer, than expected. This can be accounted for by strong double-bonding between platinum and phosphorus, together with a "cis influence" of the phosphorus atom operating through the d(xy)-type orbitals.

539.2 : 548.7

8238 THE CRYSTAL STRUCTURE OF BIS-ACETYLACETONE BERYLLIUM.

V.Amirthalingam, V.M.Padmanabhan and J.Shankar.
Acta cryst., Vol. 13, Pt 3, 201-4 (March, 1960).

The structure was determined by single-crystal X-ray diffraction. The crystals are monoclinic with a = 13.49, b = 11.32, c = 7.76 A; β = 100° 48'. There are four molecules per unit cell and the space-group was fixed as $P2_1$ with two molecules forming one asymmetric unit. Inequality relations and trial-and-error methods gave the approximate structure and refinements were made by two-dimensional Fourier summation. Due to severe overlapping in electron density, the atomic co-ordinates could not be refined to a great accuracy. Oxygen co-ordination about the beryllium is tetrahedral, and the acetylacetone radical is planar within experimental error.

539.2 : 548.7

8239 THE PROBABLE ISOMORPHISM OF PLUTONIUM (IV) AND THORIUM (IV) ACETYLACETONATES.

A.E.Comyns.
Acta cryst., Vol. 13, Pt 3, 278 (March, 1960).

539.2 : 548.7

8240 THE CRYSTAL STRUCTURE OF ACEPLEIADYLENE. A.W.Hanson.

Acta cryst., Vol. 13, Pt 3, 215-20 (March, 1960).

The crystal of acepleiadylene is monoclinic, probably $P2_1/a$, a = 11.59, b = 11.48, c = 7.93 A, β = 100.2°, Z = 4. The structure was determined by inspection of a three-dimensional Patterson synthesis, and refined with the aid of three-dimensional Fourier syntheses. The structure is disordered, the average asymmetric unit consisting of two molecules related by an approximate symmetry centre, and occupying roughly the same space. The structure is very similar to that of pyrene; the distance between adjacent parallel molecules is 3.44 A.

539.2 : 548.7

8241 STRUCTURE OF MORELLIN. B.Dayal and S.C.Mathur.

Acta cryst., Vol. 13, Pt 3, 269 (March, 1960).

Morellin is an antibiotic, extracted from the seeds of an Indian tropical evergreen Carcinia Morella (Mysoca Gamboge trec); the yellow tetragonal crystals show positive birefringence, with marked elongation along [001] and a tendency to cleave very easily parallel to (110). The unit-cell dimensions are: a = 15.7, c = 11.7 A. The empirical formula $C_{33}H_{38}O_7$ gives four molecules in the unit cell and the space group is $P4_1$. Weissenberg photographs have been taken for hk0 and 0kl reflections and the intensities have been visually estimated. A three-dimensional analysis is being carried out.

539.2 : 548.7

8242 CRYSTAL DATA FOR SOME NAPHTHALENE DERIVATIVES. J.Trotter.

Acta cryst., Vol. 13, Pt 3, 276 (March, 1960).

Data are given for: 1-naphthoic acid, $C_{11}H_8O_2$; 2-naphthoic acid $C_{11}H_8O_2$; 1,2-dichloronaphthalene $C_{10}H_6Cl_2$; 1,4-dibromonaphthalene, $C_{10}H_6Br_2$; 1,5-dinitronaphthalene, $C_{10}H_6N_2O_4$.

539.2 : 548.7

8243

THE UNIT CELLS AND SPACE GROUPS OF THE CIS- AND TRANS-ISOMERS OF DIMETHYL-9:10-DIHYDRO-ANTHRACENE-9:10-DICARBOXYLATE.

R.P.Ferrier, J.Iball and K.J.H.Mackay.
Acta cryst., Vol. 13, Pt 3, 277 (March, 1960).

539.2 : 548.7

8244

UNIT CELL AND SPACE GROUP OF ACONITINE HYDROCHLORIDE,HYDROBROMIDE, AND HYDROIODIDE. A Schuyff and J.C.Schoone.

Acta cryst., Vol. 13, Pt 3, 278 (March, 1960).

539.2 : 548.7

8245

UNIT CELLS OF CHOLINE HALIDES AND STRUCTURE OF CHOLINE CHLORIDE.

M.E.Senko and D.H.Templeton.
Acta cryst., Vol. 13, Pt 4, 281-5 (April, 1960).

Three choline halides were studied by single-crystal X-ray diffraction methods at room temperature. Choline chloride is orthorhombic, space group $P2_12_12_1$, a = 11.21 ± 0.02, b = 11.59 ± 0.02, c = 5.87 ± 0.02 A, Z = 4. Atomic coordinates were determined by least-squares refinement of three-dimensional data. Bond distances in A are: N—C (methyl), 1.53, 1.52, 1.50; N—C (side-chain), 1.60; C—C, 1.39 (each ±0.03 A). Choline bromide is orthorhombic, probable space group $Pna2_1$ or Pnam, a = 19.55 ± 0.04, b = 7.35 ± 0.03, c = 5.69 ± 0.02 A, Z = 4. Choline iodide is monoclinic, probable space group $P2_1$, a = 5.88 ± 0.02, b = 8.20 ± 0.02, c = 9.10 ± 0.02 A, $\beta = 91 \pm 1^\circ$, Z = 2.

539.2 : 548.7

8246

STRUCTURES OF 1 : 3 : 5-TRICHLOROBENZENE AT 20° C AND −183° C, AND OF 1 : 3 : 5-TRIBROMO-BENZENE AT 20° C. H.J.Milledge and L.M.Pant.

Acta cryst., Vol. 13, Pt 4, 285-90 (April, 1960).

$C_6H_3Cl_3$, $C_6H_3Br_3$ are isomorphous, $P2_12_12_1$ with Z = 4. The structure is of a layer type, the molecules being planar and inclined at about ±27° to (001). The mean thermal expansion coefficients for $C_6H_3Cl_3$ from −183° to 20° C are 58, 46, 109 × 10^{-6} along a, b, c respectively. The lack of exact triangular symmetry of the molecule is shown both in the lengths of intermolecular bonds and in the anisotropy of the atomic Debye factors. The structure is compared with those of other symmetrically-substituted ring compounds.

539.2 : 548.7

8247

THE CRYSTAL STRUCTURE OF COPPER SALICYLATE TETRAHYDRATE $Cu(OH.C_6H_4.COO)_2.4H_2O$.

F.Hanic and J.Michalov.
Acta cryst., Vol. 13, Pt 4, 299-302 (April, 1960). In German.

The crystals are monoclinic in $P2_1/c\text{-}C_{2h}^5$ with the cell a = 3,728, b = 17.70, c = 12.27 A, $\beta = 93^\circ 16'$, and 2 formula units per cell. The structure was fully determined by Fourier methods in three dimensions. The molecules $Cu(C_6H_4.OH.COO)_2-2\,H_2O$ are planar and centrosymmetric about the Cu-atoms. They are linked in the structure by a system of hydrogen bonds in which the two remaining water molecules, placed in the channels left by the large molecules, also take part. Cu is in a plane 4-coordination with two oxygens of water in trans-position at 1.92 A and two oxygens from the carboxyl group at 1.84 A distance. The other two carboxyle oxygens are outside the sphere of coordination of Cu, and the compound is therefore not a chelate. The salicylic radical is plane except for one protruding carboxyle oxygen, and the planes are arranged at intervals of 3.60 A.

539.2 : 548.7 : 539.19

8248

STUDIES OF THE STRUCTURE, THERMAL EXPANSION AND MOLECULAR VIBRATIONS OF DI-p-XYLYLENE, $C_{16}H_{16}$, AT 93 AND 291° K.

K.Lonsdale, H.J.Milledge and K.V.Krishna Rao.
Proc. Roy. Soc. A, Vol. 255, No. 1280, 82-100 (March 22, 1960).

Recent accurate determinations of crystal structures have given Debye factors which show major differences between values for different atoms and in different directions. From these it has proved possible to deduce numerical data not only for the six principal translation and libration amplitudes, the molecule being treated as a rigid body, but also for the major distorting vibrations of the molecule. Di-p-xylylene is taken as an example. A refinement, at room and low temperatures, of the structure originally given by Brown, shows that there is a concertina movement of the two benzene rings towards and away from each other, accompanied by a corresponding up-and-down movement of the methylene bridges; and also a twisting movement of each benzene ring about its normal, out of parallelism with its opposite number. All vibration amplitudes are reduced at low temperatures, but the pattern of vibrations is unchanged. The anisotropy of thermal expansion coefficients, measured by the X-ray method, is explained qualitatively; and diffuse scattering patterns are given. There is a discussion of the experimental accuracy necessary for the method to be applied, and the effect on bond-length measurements is considered.

539.2 : 548.7

8249

THE ACCURATE DETERMINATION OF THE POSITION AND SHAPE OF HEAVY-ATOM REPLACEMENT GROUPS IN PROTEINS. M.G.Rossmann.

Acta cryst., Vol. 13, Pt 3, 221-6 (March, 1960).

If two isomorphous heavy-atom derivatives of a protein are available with structure factors F_1 and F_2 respectively, then a Patterson synthesis with coefficients $(F_1 - F_2)^2$ will give accurate information about the relative position and shape of the heavy-atom peaks in the two compounds.

539.2 : 548.7

8250

INVESTIGATION OF NYLON "TEXTURE" BY X-RAY DIFFRACTION. K.Little.

Brit. J. appl. Phys., Vol. 10, No. 5, 225-30 (May, 1959).

The manner in which minor changes in the molecular and crystalline arrangement are mirrored by corresponding changes in the X-ray diffraction pattern has been used as a method of following the effects of a number of treatments and modifications in the structure and composition of the nylons. The crystalline diffraction pattern was taken from the branches of spherulites. Ageing after spinning from the melt, caused by the dissipation of strains (a fairly rapid process for the first two days) and uptake of water from the atmosphere (a process completed in 50 min), shows as increased distortion and crystallinity. The effect of swelling agents is to relieve strain and convert to the more stable α form. Phenol acts as a swelling agent in concentrations greater than 2%. The effect of introducing side-chains is to decrease the probability of links between main molecular chains (e.g. hydrogen bonds) and at the same time decrease the probability of plastic flow, so that greater reversible extensibility (i.e. rubber-like elasticity) results. The diffraction pattern of 11 nylon, $[(CH_2)_{10}\text{-}NH.CO-]_n$, is consistent with the unit cell

a = 9.6 ± 0.5 A $\alpha = 72 \pm 2^\circ$
b = 4.2 ± 0.2 A $\beta = 90$
c = 15.0 ± 0.2 A $\gamma = 63\frac{1}{2} \pm 1^\circ$

539.2 : 548.7

8251

LOW ANGLE X-RAY DIFFRACTION OF FIBROUS POLYETHYLENE.

A.S.Posner, L.Mandelkern, C.R.Worthington and A.F.Diorio.
J. appl. Phys., Vol. 31, No. 3, 536-42 (March, 1960).

Highly axially oriented fibres of linear polyethylene are shown to display four orders of well defined, meridionally directed diffraction maxima corresponding to a fundamental spacing of 408 A. An interpretation of the low angle X-ray pattern is given in terms of the fibre morphology and the Hess—Kiessig postulate as to the origin of the periodic variation in electron density. The relative macroscopic length of the fibres was systematically altered both by thermal treatment and by crosslinking, melting and recrystallization. The magnitude of the spacings observed does not bear any direct relation to the change in length incurred, but reflects the change in crystallite size that develops because of annealing, partial melting or the introduction of crosslinks. It is also shown that in a completely shrunken fibre where wide-angle X-ray diffraction shows that the crystallites are randomly arranged relative to one another, discrete diffraction maxima are observed at about 255 A. These maxima are, however, circular in shape. Intermediate types of line shapes are also observed, which depend solely on the crystallite orientation and not on the method by which the orientation is developed.

VARIOUS SOLID STRUCTURES

539.213

8252

THE RELATION OF STRUCTURE TO SOME PHYSICAL PROPERTIES OF VITREOUS AND MOLTEN BORATES.

J.Krogh-Moe.
Ark. Kemi, Vol. 14, Paper 51, 553-66 (1959).

A new theory for the structure of some glass-forming borates is proposed and correlated with a number of physical properties of the glasses and melts. Thermodynamic data are discussed to show that monovalent foreign ions tend to aggregate in pairs in borate melts. Reasons are given to believe that boron can change its coordination number very easily in pure boron oxide. This ability accounts for a high compressibility and a comparatively low viscosity of boron oxide. The electrical conductivity of alkali borates are discussed on the basis of an aggregation of the alkali in the melts.

539.213

8253 NUCLEAR MAGNETIC RESONANCE IN $B_2O_3-H_2O$ GLASSES AND BORIC ACIDS.

A.H.Silver.

J. chem. Phys., Vol. 32, No. 4, 959-62 (April, 1960).

This class of materials was investigated over the range B_2O_3 to $B_2O_3.3H_2O$. This includes "dry" glassy B_2O_3, "wet" glassy boron oxide of approximate composition $B_2O_3 \cdot \frac{1}{2}H_2O$, monoclinic and orthorhombic forms of metaboric acid, $B_2O_3 \cdot H_2O$, and triclinic orthoboric acid, $B_2O_3 \cdot 3H_2O$. The nuclear quadrupole interaction of the B^{11} isotope was measured and comparisons of the structures are made on the basis of this interaction. It is shown that all substances contain similar planar BO_3 triangular units. The presence of O—H—O hydrogen bonds, as in $B_2O_3 \cdot 3H_2O$, has a minor effect on the boron nuclear quadrupole interaction. It is concluded that BO_4 tetrahedral units exist in several of the wet glass samples as well as in monoclinic metaboric acid.

539.213

8254 ON THE CHANGE IN PHYSICAL PROPERTIES OF RADIATION SHIELDING WINDOW GLASS BY GAMMA RAY IRRADIATION.

K.Yamamoto.

J. appl. Phys. Japan, Vol. 29, No. 1, 16-20 (Jan., 1960). In Japanese.

The density, refractive index and transmittance of glass for radiation shielding should not be affected by radiation. Tests were made with pieces of window glass: the density measured by a picnometer, the refractive index by a spectrometer and the transmittance by a Beckman automatic recording spectrophotometer. The total doses of γ-radiation given to these test pieces were varied: 10^6r, 3×10^6 r, 10^7 r, 3×10^7 r and 1.16×10^8 r with a dose rate of 4.0×10^5 r/hr at 17.5 cm from a source of 10 kc Co^{60}. The result shows that the density and the refractive index are not appreciably affected. As for the transmittance, medium density glass — non-browning glass — undergoes a very slight change at a room temperature of 18° C with equally slight coloration. But high density glass is different: the transmittance is reduced a great deal by coloration. The colour, although it fades in time (conspicuously at first), when the glass is left free from radiation effect, remains even after thirty days bringing in a serious problem concerning the quality of glass for shielding radiation. The cause of coloration and subsequent fading is discussed.

539.213

8255 THE VISCOSITY OF GLASSES IN THE SYSTEM Na_2O-GeO_2.

C.R.Kurkjian and R.W.Douglas.

Phys. Chem. Glasses, Vol. 1, No. 1, 19-25 (Feb., 1960).

Measurements of the viscosity of "pure" GeO_2 and six Na_2O-GeO_2 solutions from 0.045-16.4 mole % were made at temperatures between 1000 and 1550° C. A marked lowering in the viscosity η and the activation energy E_η occurs upon the addition of Na_2O to GeO_2. Several measurements of the viscosity of "pure" GeO_2 and the 0.045 mole % Na_2O solution were made in the $\eta = 10^{11}$ to 10^{14} P range. The log η versus (1/T) plot for the pure GeO_2 was found to be a straight line from log η = 3-13.5, while that for the 0.045 mole % Na_2O solution required at least two straight lines. Several measurements of the viscosity of solutions of CaO in GeO_2 at elevated temperatures indicate the same general behaviour as for Na_2O. The miscibility limit for CaO in GeO_2 is less than 0.14 mole % CaO.

539.213

8256 ON THE STRUCTURE OF BORON OXIDE AND ALKALI BORATE GLASSES.

J.Krogh-Moe.

Phys. Chem. Glasses, Vol. 1, No. 1, 26-31 (Feb., 1960).

Nuclear magnetic resonance data are quoted which show that on adding an alkali to a boron oxide glass, the boron atoms change their coordination number, from three to four, until about 33 mole % alkali has been added and 50% of the borons are in four-fold coordination. The known borate crystal structures of borates are reviewed and they are shown to substantiate the nuclear magnetic resonance data. This result requires a new explanation for the boron oxide anomaly. Such an explanation, based partly on what the author calls "a mechanically induced coordination change of boron", is suggested.

539.214

8257 PHOTOELASTIC PROPERTIES OF POLYSTYRENE IN THE GLASSY STATE. III. STYRENE DERIVATIVES AND COPOLYMERS.

J.F.Rudd and R.D.Andrews.

J. appl. Phys., Vol. 31, No. 5, 818-26 (May, 1960).

For Pt II, see Abstr. 5820 (1958). The stress-optical coefficient, Young's modulus, and strain-optical coefficient at room temperature (27°C) have been determined for several styrene derivatives, for two copolymer systems (styrene/α-methyl styrene and styrene/methyl methacrylate) over the entire composition range, and for several copolymers of styrene with acrylates and methacrylates of varying composition. The results indicate that steric effects, particularly in the immediate neighbourhood of the chain backbone, have a very important influence on the nature of the molecular motions (and, consequently, on the photoelastic behaviour) during glassy distortions. The stress-optical coefficient becomes more negative (phenyl rings less free to orient) as a result of α-substitution on the chain or ortho-substitution on the phenyl ring. Substitution in the para-position of the phenyl ring, or increasing the separation of the phenyl ring from the chain backbone makes the stress-optical coefficient more positive (phenyl rings more free to orient); plasticizers (including residual monomer and solvents) or decreasing molecular weight have an effect in the same direction. Copolymer systems show nonideal mixing, photoelastically, indicating that interaction effects between neighbouring monomer units along the chain are of significant magnitude. This may provide a means of studying the nature of the monomer sequences in copolymers (e.g. of block and graft copolymers), and also of observing stereospecific structure in polymers.

539.214

8258 EFFECT OF VITRIFICATION OF POLYMERS ON THEIR OPTICAL ACTIVITY.

I.A.Bolotina, N.M.Bazhenov, M.V.Vol'kenshtein and Zh.S.Sogomonyants.

Fiz. tverdogo Tela, Vol. 1, No. 3, 489-98 (March, 1959). In Russian.

The angle of rotation of the plane of polarization φ exhibited a break at the vitrification temperatures T_g of methylmenthylacrylate—methylmethacrylate copolymers and polymethylmethacrylate. This break was due to discontinuous changes in the temperature dependences of the density ρ, the refractive index n and the molecular rotation ("gyration") g at T_g; the angle of rotation is given by $\varphi = K\rho g(n^2 + 2)/n$, where K is a constant depending on the wavelength of light and on the molecular weight of the polymer. The discontinuity of g at T_g is greater than the discontinuities of ρ or n; the value of Δg is larger in polymers with hydrogen bonds than in those with molecular binding. In agreement with theory, hysteresis of φ and ρ was found in these polymers on heating and subsequent cooling (at the same rate). A.Tybulewicz

539.214

8259 THE FORMATION OF INTERNAL GAS BUBBLES IN SOLIDS.

R.S.Barnes.

J. nuclear Energy, Vol. 5, No. 3-4, 301-19 (1957).

Gas bubbles produced internally in polymethyl methacrylate by heating or by irradiation have been studied. In the centre of a sample gas bubbles form after an incubation period and then grow, whereas in the surface layers, from which gas is evolved, no bubbles form. Pressure applied during the heating of samples can prevent the gas formed from precipitating. Samples in which the gas has been produced by heating contain a number of bubbles per unit volume which is a constant, but in irradiated samples this number varies depending upon the flux or the subsequent heating. The results are used to discuss the physics of the nucleation of gas bubbles in solids, and in particular the swelling which occurs in uranium upon irradiation with neutrons.

539.214

8260 SURFACE CHARACTERISTICS OF FRACTURED POLY-(METHYL METHACRYLATE).

J.P.Berry.

Nature (London), Vol. 185, 91-2 (Jan. 9, 1960).

Colour effects following fracture are discussed. Some of these can be ascribed to optical interference at the surface arising from an orientation of the macromolecules in a direction parallel to the applied stress. R.F.Barrow

539.214

8261 DETERMINATION OF THE SOFTENING TEMPERATURE OF POLYMER FILMS BY MEANS OF MEASURING THE THERMOMECHANICAL CURVES UNDER UNIAXIAL STRESS.

A.V.Sidorovich, V.S.Vashchenko and E.V.Kuvshinskii.

Zh. tekh. Fiz., Vol. 29, No. 4, 514-22 (April, 1959). In Russian. English translation in: Soviet Physics—Technical Physics (New York), Vol. 4, No. 4, 457-64 (April, 1959).

Describes an instrument for determing the softening temperature of polymer films. The thermomechanical properties of polymethyl methacrylate, polystyrene, styroflex and other materials are studied. Using styroflex as an example, it is shown that there is a great difference between the thermomechanical curves for oriented and nonoriented materials.

539.215

8262 AUTOMATIC DECANTATION FOR ROUTINE SUB-SIEVE SIZING. F.Horsfall and A.Jowett.

J. sci. Instrum., Vol. 37, No. 4, 120-2 (April, 1960).

Electronic equipment used to control sizing analysis by the beaker-decantation method is described. Capacitor-resistor circuits are used to give appropriate sedimentation times and also to control draining and filling of the decantation apparatus.

539.215 : 532.1

MEASUREMENT OF THE DENSITY OF GRANULAR SOLIDS AND LIQUIDS. See Abstr. 6728

539.216

8263 FIBRE SURFACE REPLICATION BY ROLLING. J.Mølgaard.

Nature (London), Vol. 184, 264-5 (July 25, 1959).

Surface detail of nearly cylindrical fibres of nylon, Terylene or wool can be determined by a rolling technique. A thin film of Necol cement is formed on a glass slide by dipping. Fibres are laid on, a cover glass slide placed on top and slowly pulled along to roll the fibres. Examination by phase contrast in a light microscope reveals the surface structure. Two examples are shown. R.W.Fish

539.217 : 541.18

8264 A RAPID DETERMINATION OF SOME SURFACE PROPERTIES OF SOLIDS.

H.P.Schreiber and M.H.Waldman.

Canad. J. Chem., Vol. 37, No. 10, 1782-5 (Oct., 1959).

The paper describes a method of measuring the specific area (A) and the maximum absorption capacity (V_{max}) of a solid by determining the heat of adsorption. The method is shown to be satisfactory within experimental limits for various samples of carbon black. E.G.Knowles

539.217

8265 EFFECTS OF HEAT AND PRESSURE ON THE SWELLING OF IRRADIATED URANIUM.

A.T.Churchman, R.S.Barnes and A.H.Cottrell.

J. nuclear Energy, Vol. 7, No. 1-2, 88-96 (Aug., 1958).

Small pieces of a natural uranium fuel bar, after irradiation at below 300° C, were heated to higher temperatures under various pressures. This heat-treatment produced changes in both density and micro-structure. Heating in vacuum produced an increase in volume (i.e. swelling) of about 2 per cent at 575° C, 4 per cent at 810° C, and over 20 per cent above 1000° C. Repeated thermal cycling, and reheating at low pressure after first heating at high pressure produced swelling of 10 to 20 per cent at 810-835° C. Examination of the swollen metal with optical and electron microscopes revealed bubbles between 10^{-2} and 5×10^{-6} cm in diameter and also cracks; the latter were often associated with non-metallic inclusions and were particularly prevalent in thermally cycled specimens. The conclusion is drawn that the swelling is caused by the separation of the fission gases, krypton and xenon, to form gas pockets in the metal, and the mechanism of swelling is discussed.

539.219

8266 A NOTE ON THE STRUCTURE OF GUINIER-PRESTON ZONES IN Al-Cu ALLOYS. K.Toman.

Acta cryst., Vol. 13, Pt 1, 60 (Jan., 1960).

Absolute intensity measurements were made of the diffuse streak obtained in the X-ray pattern from Al-Cu alloy. These measurements indicate that Gerold's model [Zeitschrift für Metalkunde, Vol. 45, 599 (1954) and Acta cryst., Vol. 11 Pt 3, 230 (March, 1958)] is essentially better than the model proposed by Toman [Acta cryst. Vol. 10, Pt 3, 187 (March, 1957)]. J.Adam

539.219

8267 LABYRINTH STRUCTURE IN MARTENSITE A.Mašín.

Czech. J. Phys., Vol. 9, No. 4, 530 (1959). In German.

Short discusssion of electrolytic polishing of martensite. J.E.Caffyn.

539.219

8268 THE INFLUENCE OF THE AFTER-EFFECTS OF PHASE TRANSITION ON DIFFUSION.

V.T.Borisov, V.M.Golikov and G.V.Shcherbedinskii.

Dokl. Akad. Nauk SSSR, Vol. 125, No. 4, 786-9 (April 1, 1959). In Russian.

Studies were carried out on an alloy of 27.9% Ni, 0.02% C; 0.02% Si, 0.01% S, 0.02% Al in Fe which was stable in either the austenitic or the martensitic form at room temperature. Diffusion measurements were made by the absorption method using Fe^{59}. The alloy was annealed at 1200° and one set of samples were cooled in liquid N_2 to produce the martensitic structure, another set were kept as austenite. Fe^{59} was evaporated on to the surface and the samples underwent diffusion annealing at 700-1200° C. The activity of the martensitic specimen diminished more slowly than that of the other. The temperature dependences of the volume diffusion coefficient (D) and the boundary diffusion coefficient (aD_1/D) were calculated. Results indicate a hindrance to the diffusion process by the boundary of separation ahead of the diffusion front. A.L.Mackay

539.219

8269 ON PHASE PRECIPITATION OF SURFACE-ACTIVE ADDITIONS ON CRYSTAL LATTICE DEFECTS IN METALS. V.N.Rozhanskii.

Dokl. Akad. Nauk SSSR. Vol. 128, No. 6, 1171-3 (Oct. 21, 1959). In Russian.

Localized precipitation of surface-active alloying additions (about 1%) of mercury, gallium, bismuth and tin in zinc was studied. Microscopic examination of the alloys investigated at room temperature showed that small particles ~ 10^{-4} cm of a Hg-rich phase were precipitated mainly on dislocations and along the block- and grain-boundaries. In Ga-bearing zinc, precipitation of plate-like hexagonal crystallites, ~ 10^{-3} –10^{-4} cm large and orientated in the basal plane, was observed; these precipitates were also located mainly on the lattice defects and had sometimes an irregular shape, probably indicating the presence of a liquid phase. A similar, dispersed precipitate was observed in Bi-bearing zinc; in this case however, the precipitate particles were not confined to the lattice defects. In the case of zinc alloyed with tin, the precipitated phase appeared at the grain boundaries in the form of dendrite-like formations. No similar effect was observed in Pb-bearing zinc. The findings are discussed in relation to the effect of surface-active additions on the strength of metals. M.H.Sloboda

539.219

8270 ON THE PROBLEM OF SUPERSTRUCTURE IN ALUMINIUM BRONZE. V.E.Panin and É.K.Zenkova.

Dokl. Akad. Nauk SSSR, Vol. 129, No. 5, 1024-7 (Dec. 11, 1959). In Russian.

The existence of a disorder—order transformation, taking place in the 15.9 at.% Al—Cu alloy at 280° C, was confirmed by the results of specific heat, electrical resistivity, and hardness measurements. The effect of the quenching temperature on the properties of the alloy and on the ordering transformation was studied, as well as the effect of the superlattice on the compressive strength of the alloy, tested at various temperatures and at various deformation rates. M.H.Sloboda

539.219

8271 EFFECT OF THE QUENCHING TEMPERATURE ON ESTABLISHMENT OF THE SHORT-RANGE ORDER.

L.E.Popov and G.I.Karpov.

Dokl. Akad. Nauk SSSR, Vol. 129, No. 5, 1028-30 (Dec. 11, 1959). In Russian.

The kinetics of ordering (formation of the K-state) in the 16.5 wt % Cr—Ni alloy were studied by measuring (at room temperature) electrical resistivity, ρ, of specimens, quenched from temperatures ranging from 650 to 1100° C and aged at 200, 250 and 300° C. In every case the rate of the increase in ρ of the aged specimens, rapid in the initial stages of ageing, decreased with time, the total gain in ρ increasing monotonically with increasing quenching temperature. These effects were attributed to the effect of the quenching temperature on the degree of short-range order and the concentration of quenched vacancies in the quenched specimens. The activation energy for motion of vacancies in the investigated alloy was calculated; its value of approx. 38.7 kcal/mol was very near to that of 39 kcal/mol for motion of vacancies in Ni. M.H.Sloboda

539.219

8272 THE THEORY OF THE SCATTERING OF X-RAYS AND THERMAL NEUTRONS BY MULTICOMPONENT SUBSTITUTION ALLOYS. A.A.Smirnov and E.A.Tikhonova.

Fiz. tverdogo Tela, Vol. 1, No. 9, 1393-400 (Sept., 1959). In Russian.

Distortions of the crystal lattice due to the presence of atoms of differing radii are considered. The authors use the elastic continuum model for the atomic displacements and assume that the displacements of any one atom may be superposed. The kinematic theory is used and a relation between the scattered intensities for X-rays and slow neutrons for a given alloy is deduced.

M.G.Priestley

539.219

8273 LEAD–LITHIUM SHIELDING ALLOY - METALLURGICAL STUDIES. D.H.Jansen, E.E.Hoffman and D.M.Shepherd.

J. nuclear Mater., Vol. 1, No. 3, 249-58 (Oct., 1959).

Alloying and casting studies conducted on a lead-0.69 wt% lithium alloy, a proposed shielding material, are presented. The information obtained during this investigation was used in connection with the making of an experimental, laminated slab, 90 cm square and 10 cm thick, of the lead–lithium alloy. This slab was used to determine the neutron and gamma-ray shielding characteristics of the material. Shielding tests have demonstrated the effectiveness of the alloy in suppressing secondary gamma-ray production. Mechanical property tests were conducted on the lead–lithium alloy and the results compared to those for a lead-0.06 wt% copper alloy, also being considered for shielding applications. It was found that the lead–lithium alloy has superior strength at room temperature, but the lead–copper alloy has superior creep strength at 110°C. Tests at 110°C in air indicate that the lead-0.69 wt% lithium alloy oxidizes more rapidly than pure lead. The lead–lithium alloy is attacked by water with an accompanying volume increase and cracking. Corrosion was much more severe in boiling water than in room-temperature water. The lead–lithium alloy has good rolling characteristics. No cracks or surface defects were observed on a piece which was rolled to 92.5% reduction.

539.219

8274 SOME PROPERTIES OF ZIRCONIUM–NIOBIUM ALLOYS. Yu.F.Bichkov, A.N.Rozanov and D.M.Skorov.

J. nuclear Energy, Vol. 5, No. 3-4, 402-7 (1957). English translation of article in Atomnaya Energiya, Vol. 2, 146 (1957).

The constitution of zirconium–niobium alloys has been investigated and modifications to the exsisting equilibrium diagram are suggested. The mechanical properties of the alloys at room temperature have been determined and the hot-strength at temperatures of up to 750°C has been deduced from hardness measurements. Also, hardness has been measured after low-temperature ageing treatments. Measured results are correlated with the equilibrium diagram. The resistance of the alloys to oxidation in air has been determined in the temperature range 570 to 650°C.

539.219 : 539.3

YOUNG'S MODULUS OF ZIRCONIUM–NIOBIUM ALLOYS. See Abstr. 8105

539.219

8275 A REVIEW PAPER ON THE CONSTITUTION OF URANIUM–MOLYBDENUM ALLOYS.

A.J.Carrea, D.R.F.West and J.G.Ball.

J. nuclear Energy, Vol. 7, No. 3-4, 189-98 (Sept., 1958).

Reports of investigations of the constitution of uranium–molybdenum alloys are summarized and differences between the proposed equilibrium diagrams are discussed. It is apparent that the differences are due partly to the difficulty of establishing equilibrium in the solid state transformations. A compiled equilibrium diagram is shown.

539.219

8276 THE PLUTONIUM–URANIUM SYSTEM. F.H.Ellinger, R.O.Elliott and E.M.Cramer.

J. nuclear Mater., Vol. 1, No. 3, 233-43 (Oct., 1959).

The plutonium–uranium phase diagram has been constructed from thermal, dilatometric, metallographic and X-ray diffraction data. All alloys solidify as a body-centred cubic solid solution, the phase resulting from the complete mutual solid solubility of ϵ-plutonium and γ-uranium. ϵ-plutonium is the only plutonium allotrope in which uranium is appreciably soluble, whereas γ-uranium dissolves a maximum of 15 at.% plutonium, and β-uranium dissolves about 20 at.% plutonium. Two intermediate phases, both having wide homogeneity ranges, exist in this alloy system, and one of them is stable at elevated temperatures only.

539.219

8277 THE ALLOY SYSTEM URANIUM–TITANIUM–ZIRCONIUM. B.W.Howlett.

J. nuclear Mater., Vol. 1, No. 3, 289-99 (Oct., 1959).

The uranium–titanium–zirconium system in the composition range to 40 atomic per cent titanium, 70 atomic per cent zirconium is reported in nine isothermal sections between 575° and 1000°C. The principal features of the alloys are discussed.

539.219

8278 THE DIRECT OBSERVATION OF ANTI-PHASE DOMAIN BOUNDARIES IN ORDERED COPPER–GOLD (CuAu) ALLOY. A.B.Glossop and D.W.Pashley.

Proc. Roy. Soc. A, Vol. 250, 132-46 (Feb. 24, 1959).

The periodic arrangement of anti-phase domain boundaries in the ordered alloy CuAu II has been determined by direct resolution of the domains in the electron microscope. High contrast in the image is obtained by using the dark-field technique with tilted electron illumination so as to maintain a resolution of better than 20 A. The image of the domain boundaries consists of a series of closed loops, which are arranged in such a way that there are zones of regularly spaced anti-phase boundaries with a period of 20 A. In addition, some of the anti-phase boundaries terminate within the specimen. This is correlated with the effect of dislocations on the formation of the anti-phase boundaries. The transmission electron diffraction pattern from the alloy film is analysed in detail. The interpretation given by earlier workers is shown to be inadequate, and an alternative interpretation based upon the occurrence of secondary diffraction is put forward. The relevance of this interpretation to the mechanism of formation of the electron microscope image is discussed.

539.219

8279 ALLOYING BEHAVIOR OF THIN BIMETAL FILMS, SIMULTANEOUSLY OR SUCCESSIVELY DEPOSITED. R.B.Belser.

J. appl. Phys., Vol. 31, No. 3, 562-70 (March, 1960).

Studies of the alloying of thin bimetal films of 20 metal pairs have been conducted by measurement of changes in the properties of the films before and after heating to successively higher temperatures in vacuo. Films consisted of layers of about 1000 A of each metal consecutively deposited or of a single layer of 2000 A formed of two metals deposited simultaneously. Techniques of study included visual examination of colour changes, measurements of changes in electrical resistivity and temperature coefficient of resistance, metallography, X-ray diffraction, electron microscopy and diffraction, and measurement of frequency changes of piezoelectric resonators coated with a metal pair. Regardless of the method of coating, i.e., evaporation, sputtering or electroplating, films were found to interdiffuse or alloy at or below the temperature of recrystallization of the metal of higher melting point. The order of deposition of the films affected their subsequent behaviour. Films of aluminium formed an oxide coating during a few minutes storage in vacuo; the oxide appreciably retarded diffusion between the layers until a temperature of about 400°C was reached. Simultaneous evaporation produced films which alloyed readily at relatively low temperatures or, in the absence of intrinsic alloying affinities of the metal pair, films of highly imperfect structure. The imperfection of the latter was exhibited by reductions of up to 90% in the electrical resistance of the films upon annealing. By the methods outlined valuable studies of the properties of metals can be conducted with microquantities of the metals at temperatures below $0.40^{\circ} K_m$ (melting point °K); and alloys unavailable commercially can be prepared in the laboratory at minimum expense.

539.219

8280 DEPOSITION BY THERMAL EVAPORATION OF THIN FILMS OF TITANIUM AND ZIRCONIUM FOR TRITIUM TARGETS. V.D.Scott and L.W.Owen.

Brit. J. appl. Phys., Vol. 10, No. 2, 91-3 (Feb., 1959).

Equipment and procedure are described for applying thin films of titanium and zirconium as tritium carriers to backings of copper, gold and platinum. A large proportion of the coatings prepared absorbed high atom ratios of tritium, titanium being more satisfactory in this respect than zirconium. It is suggested that defects in the coating arise mainly from the undesirable reaction of the metals with residual gases, particularly oxygen, during evaporation in the vacuum chamber. Firstly, this causes stress, brittleness, and owing to lack of adhesion, blistering of the deposit; secondly absorption of tritium is inhibited by the oxide film on the metal surface, and the total amount absorbed reduced as a result of there being fewer lattice sites available for the tritium. An electron diffraction examination showed that although the deposits appeared bright and metallic, a thin protective oxide film was present on the evaporated titanium and zirconium.

539.23

8281 ELECTRON DIFFRACTION STUDY OF EVAPORATED CARBON FILMS.

J.Kakinoki, K.Katada, T.Hanawa and T.Ino.

Acta cryst., Vol. 13, Pt 3, 171-9 (March, 1960).

The structure of evaporated carbon films was studied by electron diffraction using a camera with a rotating sector. Films of 100 A thickness were used. Eleven halos were observed in the range of $s = (4\pi/\lambda) \sin\theta < 33\,\mathrm{A}^{-1}$. Both the radial distribution and the correlation methods were applied to the analysis of data. Two kinds of bond distances were found to exist in the film. One is the graphite-like 1.41 A, and the other is the diamond-like 1.55 A. The number of the diamond-like distances is somewhat larger than that of the graphite-like distances. Mean deviations of these equilibrium distances are 0.11 ~ 0.12 A, which are about twice as large as those found in free molecules. The atomic distribution around any atom becomes uniform beyond several Angström units. The probable atomic arrangement in the film is a three-dimensional random network consisting of graphite-like and diamond-like configurations. A model of such atomic arrangement is proposed and compared with structures of other amorphous carbons.

539.23

8282 STACKING FAULTS IN GOLD FILMS OBTAINED BY EVAPORATION IN VACUUM.

J.Despujols.

C.R. Acad. Sci. (Paris), Vol. 250, No. 5, 837-9 (Feb. 1, 1960).
In French.

Thin gold films prepared by vacuum evaporation onto cleavage surfaces of crystals were examined both by electron microscopy and electron diffraction, Stacking faults that occur in large numbers can be observed by X-ray diffraction; faults occurring in small numbers need the electron microscope to show them up. Representative electron micrographs and diffraction patterns are shown.

A.E.I. Research Laboratory

539.23

8283 FORMATION OF VERY THIN NICKEL FILMS. ACTION OF AN ELECTRIC FIELD.

A.Colombani and G.Goureaux.

C.R. Acad. Sci. (Paris). Vol. 250, No. 7, 1264-6 (Feb., 15, 1960).
In French.

The field was applied during both the evaporation and the subsequent recrystallization. The behaviour of the Hall coefficient and the temperature coefficient of resistance indicated that there was less tendency to show non-metallic properties than in films prepared without a field.

C.Hilsum

539.23

8284 VOLATILIZATION OF SILICON WITHOUT THE USE OF A CRUCIBLE.

R.M.Voitenko, T.N.Dunayeva and E.A.Kolenko.

Fiz. tverdogo Tela, Vol. 1, No. 2, 294-5 (Feb., 1959). In Russian.

Vacuum-deposited Si films, free from the contaminants usually picked up from crucible material, were obtained by using electron bombardment heating to melt one end of a suitably supported Si rod. A spiral W cathode was used for this purpose, and conveniently placed Ta screens served to confine the molten zone to the end of the Si rod only, and to prevent condensation of the W vapour on the Si supports.

M.H.Sloboda

539.23

8285 POLYHEDRAL HOLES IN EVAPORATED AuCu FILMS.

V.A.Phillips.

J. appl. Phys., Vol. 31, No. 4, 697-8 (April, 1960).

A transmission electron microscope study of ordered (001) films of Au 50 at. % Cu made by evaporation in vacuo onto cleaved rocksalt at 400° C showed (a) the presence of a 6 sided roughly hexagonal single crystal area in the film about 2μ across apparently surrounded by polycrystals, the 3 pairs of sides being nearly parallel to $[\bar{1}00]$, $[\bar{1}20]$, and $[\bar{1}\bar{1}0]$, respectively, (b) streaks within this crystal interpretable as twins on (111), (c) holes through the film tended within this crystal to be polyhedral, developing sides parallel to $\langle 100\rangle$ and $\langle 110\rangle$. The latter observation indicates that the effective supersaturation during evaporation is relatively low.

539.23 : 539.3

8286 A STUDY OF THE DEFORMATION AND FRACTURE OF SINGLE-CRYSTAL GOLD FILMS OF HIGH STRENGTH INSIDE AN ELECTRON MICROSCOPE.

D.W.Pashley.

Proc. Roy. Soc. A, Vol. 255, 218-31 (April 5, 1960).

Single-crystal films of gold in (111) orientation, and 500 to 2000 A in thickness, were prepared by an evaporation technique. A device was constructed to allow these films to be strained in a controlled manner while under observation inside the inside the electron microscope (Siemens Elmiskop I). It is shown, by the absence of observable plastic deformation, that the films deform elastically up to abnormally high strain values. This is confirmed, in the case of 500 A films, by precision electron diffraction measurements, which indicate elastic strains as high as 1 to 1.5%. This represents a tensile strength several times that of hard-drawn gold wire. The high tensile strength occurs despite the presence of a high density of dislocations. Failure occurs once the elastic limit is exceeded. Detailed examination of the fractured specimens reveals that highly localized plastic deformation occurs immediately before fracture. The nature of the fracture process has been deduced from the micrographs, and it is shown that the catastrophic failure occurs as a result of the high stress level which exists when plastic deformation occurs, coupled with the stress concentrations which occur as localized thinning takes place.

539.23 : 621.316.843

8287 PREPARATION OF METAL FILM RESISTORS ON LAMINATED PLASTICS.

G.Siddall and G.Smith.

Brit. J. appl. Phys., Vol. 10, No. 1, 35-9 (Jan., 1959).

Some properties of metal resistance films on resin-bonded glass cloth have been investigated. Plastics laminates bonded with different polymers were coated with films of nickel—chromium alloy by vacuum evaporation and with sandwich films of gold between bismuth oxide layers deposited by sputtering. Glow discharge cleaning was essential before evaporation to make adherent films. Silicone resin bonded laminates were unsuitable for preparing stable resistors, because they had a large number of surface defects produced by strains arising during the curing process. Melamine bonded laminates were decomposed by ion bombardment during discharge cleaning or sputtering. The resistors were tested under a load of $1\ \mathrm{W/in.}^2$ of film area over a period of 3 months. Resistors which became non-conducting during the test were found to break down invariably along surface scratches in the base material. The most stable resistors on plastics bases were produced with epoxy or polyester resin bonded laminates, and with the metal films protected by a melamine lacquer. Nickel-chromium films up to 800 Ω/square and gold films up to 50 Ω/square reached a stable resistance value after an ageing period of about eight weeks.

539.23 : 621.317.73

8288 INSTRUMENT FOR RECORDING THE RESISTANCE DURING THE DEPOSITION OF A THIN FILM.

J.A.Bennett and T.P.Flanagan.

J. sci. Instrum., Vol. 37, No. 4, 143-4 (April, 1960).

The decrease in the electrical resistance of a metallic film is followed during the deposition of the film. This is achieved by recording the instant at which certain fixed resistance values are attained. When one balance point is reached the value of the reference resistance in one arm of a Wheatstone bridge is changed to the next balance point by a uniselector actuated by a valve amplifier.

X-ray and Electron Microscope Examination

529.26

8289 SUMMARIZED PROCEEDING OF A CONFERENCE ON X-RAY ANALYSIS, LEEDS, APRIL 1959.

Brit. J. appl. Phys., Vol. 11, No. 3, 89-95 (March, 1960).

The 1959 Spring Conference of the X-Ray Analysis Group of The Institute of Physics was held in the University of Leeds, on 17 and 18 April, 1959. The conference was devoted to clay minerals and biological fibres.

539.26

8290 MEASUREMENT OF TINPLATE THICKNESS USING FLUORESCENT X-RAYS EXCITED BY A RADIOACTIVE SOURCE.

J.F.Cameron and J.R.Rhodes.

Brit. J. appl. Phys., Vol. 49, No. 1, 49-52 (Jan., 1960).

Using tritium bremsstrahlung as an X-ray source and a thin-windowed scintillation counter as a detector, a method of measuring the thickness of tinplated steel over the range 0-1.55 microns (1.00 lb per basis box) has been developed. The technique depends on absorption of the iron fluorescent X-radiation by the tin layer. An accuracy of 1% can be obtained with 95% confidence in a counting time of 30 seconds.

539.26

8291 X-RAY MEASUREMENT OF THERMAL EXPANSION PERPENDICULAR TO THE LAYER PLANES OF ARTIFICIAL AND NATURAL GRAPHITES. E.G.Steward and B.P.Cook.

Nature (London), Vol. 185, 78-80 (Jan. 9, 1960).

Reports a number of more-or-less conflicting results and describes recent experiments on graphite of varying degrees of perfection. For natural graphite the findings closely follow those of Nelson and Riley; for less well graphitized material there is evidence that the coefficient of expansion is a function of temperature, but more work at higher temperatures (> 1200°C) is necessary. For fully ordered graphite a suggested variation of expansion coefficient with temperature is given and its implications discussed. J.Thewlis

539.27

8292 SUMMARIZED PROCEEDINGS OF A CONFERENCE ON ELECTRON MICROSCOPY — EXETER, JULY 1959.

J.A.Chapman and M.J.Whelan.

Brit. J. appl. Phys., Vol. 11, No. 1, 22-32 (Jan., 1960).

539.27

8293 HIGH-RESOLUTION SHADOW-CASTING TECHNIQUE FOR THE ELECTRON MICROSCOPE USING THE SIMULTANEOUS EVAPORATION OF PLATINUM AND CARBON.

D.E.Bradley.

Brit. J. appl. Phys., Vol. 10, No. 5, 198-203 (May, 1959).

Conventional shadowcasting techniques using heavy metals as shadowing materials suffer from a limited resolution imposed by the granulation of the metal. A method for the simultaneous evaporation of platinum and carbon is described. This produces a deposit which does not granulate but at the same time has the high electron scattering power required for shadowing purposes. The properties of the deposit relating to its suitability as a shadowing material are fully discussed. The method is illustrated by means of various applications, one of which, the cleavage face of a sucrose crystal, exhibits monomolecular steps 11 A high.

539.27

8294 CORRECTION OF ERRORS IN ELECTRON STEREO-MICROSCOPY. O.C.Wells.

Brit. J. appl. Phys., Vol. 11, No. 5, 199-201 (May, 1960).

A method is described for analysing electron stereomicrographs. Three position co-ordinates are computed for each object point from the four co-ordinate measurements (two from each micrograph) that are available for each point from the stereo pair. The method allows for the correction of tilt error and perspective error, and for the estimation of the magnitude of the errors that remain. An example of the application of the method is described.

539.27

8295 ELECTRON MICROSCOPIC OBSERVATIONS ON THE KI SINGLE CRYSTAL. T.Tomiki.

J. Phys. Soc. Japan, Vol. 14, No. 2, 230-1 (Feb., 1959).

This paper reports electron microscope studies of alkali halides. KI single crystals appear to differ from KCl, NaCl and KBr single crystals in cleavage and irradiation damage properties.
A.E.I. Research Laboratory

539.27

8296 ELECTRONMICROSCOPIC OBSERVATION OF THE KCl CRYSTAL CONTAINING POTASSIUM COLLOID PARTICLES. T.Hibi and T.Tomiki.

J. Phys. Soc. Japan, Vol. 14, No. 3, 375-6 (March, 1959).

A KCl single crystal was heated in an atmosphere of potassium vapour for 4 hours at 550°C and then allowed to cool to room temperature over 12 hours. Optical microscopic examination showed that dislocation lines were decorated with potassium particles. A freshly cleaved (001) face was then examined in the electron microscope. using a replica technique. Hemispherical pits surrounded by tiny droplets were observed. The pits had diameters of 0.5 μ which were approximately the same as the diameters of the colloidal particles seen in the optical microscope. It is concluded that the pits are produced by the scattering of the colloidal metal particles during cleaving and the droplets appear as satellites around the pits.
J.Iball

PHYSICAL CHEMISTRY

THERMOCHEMISTRY . REACTIONS

541.12 : 532.5

8297 ON CHEMICAL REACTIONS IN INTERNAL FLOW SYSTEMS. P.L.Chambré.

Appl. sci. Res. A, Vol. 9, No. 2-3, 157-68 (1960).

The basic equations for a non-isothermal homogeneous reaction in an internal flow system with a fully established velocity field are presented. It is shown that the specie concentrations can be found from a single function, i.e. the degree of advancement of the reaction, while the temperature is determined through a generalized enthalpy function which takes into account the thermal exchange with the exterior. Under mildly non-isothermal conditions, to which the analysis applies primarily, the determination of the two basic functions reduces to the solution of two linear parabolic equations and their associated Sturm—Liouville systems. An illustration of the analysis is given and a number of extensions are indicated.

541.12

8298 MECHANICS OF ATOMIC RECOMBINATION REACTIONS. D.L.Bunker.

J. chem. Phys., Vol. 32, No. 4, 1001-5 (April, 1960).

A treatment is developed by means of which it is possible to calculate an equilibrium constant for the formation of a collision complex from a pair of chemically interacting atoms. For iodine atoms, this leads to a value of the rate constant for $I + I + + M \rightarrow I_2 + M$, if the mechanism is $2I \rightleftharpoons I_2^*(^1\Sigma)$, $I_2^* + M \rightarrow I_2 + M$. The rate constant so calculated agrees with that obtained by a statistical procedure (Keck, Abstr. 9161 of 1958). The calculation also furnishes enough information about the mechanical details of collisions so that the contribution of molecular states other than $^1\Sigma$ to recombination may be deduced. As a result a fairly conclusive discussion may be given of the plausibility of the various detailed mechanisms thus far suggested. A most likely mechanism and a possible calculation based on it are proposed.

541.12

8299 VARIATIONAL THEORY OF CHEMICAL REACTION RATES APPLIED TO THREE-BODY RECOMBINATIONS.

J.C.Keck.

J. chem. Phys., Vol. 32, No. 4, 1035-50 (April, 1960).

A "variational" theory, which gives a least upper bound to the rate of a chemical reaction, is presented. The reaction is represented by the motion of a point in phase space across a trial surface dividing the "initial" and "final" chemical states. The trial surface is well defined in regions of phase space where interactions causing reaction are negligible, but is subject to arbitrary variations otherwise. It is shown that a least upper bound to the reaction rate can be obtained by calculating the rate at which representative points cross the "trial" surface and then minimizing this rate with respect to allowed variations of the surface. Explicit calculations of the recombination rate of attracting atoms in the presence of repulsive third bodies are made for a simple trial surface having one adjustable parameter. At low temperatures, the experimental rate constants are quite close to the theoretical bounds; at high temperatures, the experimental data fall away from the bounds in a manner which can be understood in terms of various approximations contained in the theory. Promising methods of improving the agreement between theory and experiment are discussed.

541.12

8300 EXCHANGE OF RADIOCHLORINE BETWEEN HYDROGEN CHLORIDE AND CARBON TETRA CHLORIDE. "RED FORM" OF SOLID HYDROGEN CHLORIDE.

I.M.Pearson and C.S.Garner.

J. chem. Phys., Vol. 32, No. 4, 1214-17 (April, 1960).

Radiochlorine-36 was used to investigate the $HCl^*—CCl_4$ exchange in systems of high purity at 22-35°C in the dark and in sunlight for exchange times up to 200 and 117 days, respectively, with solutions 0.14-0.18f in HCl and 10f in CCl_4. The exchange rate law is not known, but results are presented in terms of an assumed bimolecular rate law, $R = k(HCl)(CCl_4)$. For the dark exchange,

$k \leq 2 \times 10^{-11}$ litre mole ^{1}sec ^{1}, an upper limit which is about 4×10^{7} times smaller than the upper limit set by earlier workers. There is no evidence that the exchange is accelerated in sunlight. The so-called "red form" of solid HCl was observed during the work, as well as solid HCl which was yellow. An apparent red-inducing impurity was found separable from most of the HCl by slow vacuum distillation of the latter from a -140^{0}C bath to a trap at -196^{0}C. The solid HCl distillate was colourless and failed to develop a red colour even in six flash freezings at -196^{0}C, whereas the pale yellow HCl residue from the distillation gave a rose-red colour on being flash frozen at -196^{0}C. Volatility characteristics of the latter apparent impurity suggest that, if it be an oxide of nitrogen as proposed by Clusius and Haimerl, it is probably not NO but rather N_2O or possibly N_2O_3. If the red colour arises from imperfection colour centres in the crystal lattice of HCl, as suggested by Johnston and Martin, generation of the colour seems to require both reasonably rapid freezing at or near -196^{0}C and the presence of an impurity separable from the HCl by a proper distillation. Consequently the flash-freeze test for traces of HCl in other substances must be interpreted with caution.

541.12

8301 UNIMOLECULAR DECOMPOSITION OF CHEMICALLY ACTIVATED SEC-DEUTEROBUTYL RADICALS FROM D ATOMS PLUS CIS-BURENE-2.

R.E.Harrington, B.S.Rabinovitch and R.W.Diesen.
J. chem. Phys., Vol. 32, 1245-8 (April, 1960).

Chemically activated sec-deuterobutyl radicals, were produced at 25^{0}C by the reaction of D atoms with cis-butene-2. These vibrationally excited species contain an increment of energy above that of the corresponding light radicals as formed from H plus cis-butene-2 in a previous study (Abstr. 7563 of 1959). Apparent rate constants for the unimolecular decomposition to propylene of the deuterobutyl radicals were obtained as a function of pressure relative to the collision induced stabilization process. Theoretical values for the rate constants at the limits of high and low pressures were calculated using a direct count for the density of vibrational energy levels. The calculated and experimental results are compared with one another, and with the results of the previous study of the sec-butyl radical decomposition. The expected energy effect is observed; the deuterobutyl radicals appear slightly more monoenergetic than the equivalent nondeuterated species.

541.12

8302 SOME ASPECTS OF THE THEORY OF UNIMOLECULAR GAS REACTIONS. E.K.Gill and K.J.Laidler.

Proc. Roy. Soc. A, Vol. 250, 121-31 (Feb. 24, 1959).

An examination is made of the experimental data for the low-pressure second-order unimolecular decompositions of ozone, nitrous oxide, hydrogen peroxide, nitrogen pentoxide, ethane (into two methyl radicals), cyclopropane and ethyl chloride. The rates are considered in the light of the theories of energization due to Hinshelwood, Kassel, and Rice and Ramsperger (H.K.R.R.) on the one hand and to Slater on the other. For nitrous oxide, hydrogen peroxide and ethane Slater's rates of energization are too low by a significant factor, whereas the H.K.R.R. theories can give a satisfactory interpretation. For ozone, nitrogen pentoxide, cyclopropane and ethyl chloride the Slater rates of energization appear to be of the correct order of magnitude, while the H.K.R.R. rates are too high unless one employs fewer degrees of freedom than are actually in the molecule. These results are explained on the hypothesis that Slater's theory is correct as far as the breakdown of the energized molecule A* is concerned, but is not always correct with regard to the rate of formation of A*. If flow of energy between the normal modes can take place a molecule A', energized in the H.K.R.R. sense but not having the right distribution of energy to be energized in Slater's sense, may become an A*. Reasons are advanced for believing that in small molecules the flow of energy will tend to be more rapid than in large ones. A steady-state treatment of the overall process is presented.

541.12

8303 THE REACTIONS OF OXYGEN AT DARK AND IRRADIATED ZINC OXIDE SURFACES.

T.I.Barry and F.S.Stone.
Proc. Roy. Soc. A, Vol. 255, No. 1280, 124-44 (March 22, 1960).

Studies of the kinetics of adsorption of oxygen on zinc oxide over the temperature range from 25^{0} to 290^{0}C have provided evidence for two distinct types of chemisorption, one prevalent below 200^{0}C and the other above 300^{0}C. This pattern of activity has been confirmed by measurements of desorption rates over the same temperature range. The mode of preparation and pretreatment of the oxide exert a strong influence on the adsorption behaviour, and these differences are accentuated when the processes of adsorption and desorption are studied in the presence of irradiation in the ultraviolet and visible. Photodesorption of oxygen is confirmed to be the normal behaviour for zinc oxide, but photo-adsorption has been observed under conditions of high excess zinc concentration. The photo-effects are especially marked below 300^{0}C. The adsorption studies have been followed up by experiments on the rate of the intermolecular oxygen reaction $O_2^{18} + O_2^{16} \rightleftharpoons 2O^{18}O^{16}$, and on the influence of irradiation on this catalysis. It is evident that irradiation stimulates both adsorption and desorption, but the balance between them depends on the previous history of the specimen. The experiments with heavy oxygen have also included a brief study of oxygen exchange with zinc oxide at 400 to 500^{0}C. The results as a whole are discussed in terms of the model of zinc oxide as an n-type semiconductor with interstitial zinc, and oxygen chemisorbed as O^- and O^{2-}, respectively, are held to be mainly responsible for the phenomena observed. The relationship with conductivity studies is emphasized and the depletive chemisorption of oxygen, forming a boundary layer, is discussed in some detail. The depletion of electrons is not exhaustive for normal specimens of zinc oxide, and the treatment of this case leads to an expression consistent with the observed kinetics. Several possible mechanisms for photo-adsorption are put forward, and the association with high donor concentrations is discussed. Interstitial zinc diffusing under the influence of the electric field of chemisorbed oxygen is considered to play an important role in specimens heated above 300^{0}C.

541.12

8304 PROPAGATION OF FLAMES SUPPORTED BY A ZEROETH-ORDER CHEMICAL REACTION.

J.O.Hirschfelder and S.S.Van Domelen.
Phys. of Fluids, Vol. 3, No. 2, 210-16 (March-April, 1960).

Flames supported by zeroeth-order chemical reactions have two very useful unique properties. Their characteristics are independent of diffusion, and the chemical reactions are completed at a finite point in space. These properties should make zeroeth-order flames ideally suited to serve as "global" reactions for complicated flame systems involving either three-dimensional geometry or time-dependent phenomena. Extensive tables are given for the properties of steady-state one-dimensional zeroeth-order flames. Good agreement with the numerical calculations is obtained by using a simple approximation (based upon the Adams and Wilde approach) which results in simple closed form expressions for the flame variables.

541.12

8305 SOME EXPERIMENTAL RESULTS ON THE IMPACT SENSITIVITY OF MERCURY FULMINATE.

M.P.Murgal and A.K.Ray.
Brit. J. appl. Phys., Vol. 10, No. 3, 132-4 (March, 1959).

50% explosion efficiency heights, times of impact and pressures on the impact sensitivity of mercury fulminate are given. These pressure estimations, together with similar measurements by other workers, have been compared with the theoretical calculations (see Abstr. 815 of 1957). There is a general agreement between the experimental and theoretical pressures.

541.12

8306 EMISSION AND ABSORPTION OF LIGHT BEHIND THE DETONATION FRONT. C.H.Johansson and T.Sjölin.

Nature (London), Vol. 185, 523-4 (Feb. 20, 1960).

The light emitted by a detonating high explosive is masked by a layer of air which has been raised to a high temperature by compression. If the material is detonated under water, it is possible to see a luminous zone in the reacting solid. Some light is absorbed in a material deficient in oxygen since carbon particles are produced in the cooler region at the surface of the solid. Blasting gelatine freed from bubbles does not produce carbon particles on detonation. The surface layer of gas from PETN may be prevented from cooling if the solid is coated with blasting gelatine prior to detonation.

E.R.Wooding

541.12

8307 OBSERVATIONS OF DETONATION IN SOLID EXPLOSIVES BY MICROWAVE INTERFEROMETRY.

G.F.Cawsey, J.L.Farrands and S.Thomas.
Proc. Roy. Soc. A, Vol. 248, 499-521 (Dec. 9, 1958).

Detonation processes have been observed in narrow, heavily confined, columns of solid explosive by a new microwave interferometric technique. The technique is described and a multiple-beam theory of fringe shape is given. The location, with respect to the detonation front, of the surface reflecting the microwaves is discussed. Detonation velocity as a function of distance along the column is derived from an oscilloscope display of the fringe pattern. The calculation of the detonation velocity requires a knowledge of the wavelength of the microwaves in the explosive. For this purpose the relative permittivities of a number of explosives are given as a function of their pressed density. The accuracy and applications of the method are discussed. Experiments on tetryl are described in which the technique is evaluated by observing the detonation velocity for a range of densities, and is applied to resolution of the velocity transient during growth to detonation. A simple theory of growth is used to estimate the reaction zone length (0.4 mm) and the activation energy (2 kcal/mole) in the detonation of tetryl.

ELECTROCHEMISTRY

541.13

8308 THE OVERVOLTAGE OF HYDROGEN. M.A.Lopez-Campillo.

Bull. Soc. Franc. Elect., Vol. 9, 745-9 (Dec., 1959). In French.

A review of the various theories proposed to explain the phenomenon of overvoltage of hydrogen during electroysis. These are 22 references.

G.I.W.Llewelyn

541.13

8309 OVERVOLTAGE AND DIFFUSION THROUGH IRON AND PALLADIUM. J.N.Andrews and A.R.Ubbelohde.

Proc. Roy. Soc. A, Vol. 253, 6-15 (Nov. 17, 1959).

Observations are recorded on X-ray spectra diffracted from cathodes of iron and palladium during actual discharge and diffusion of hydrogen. For iron, no expansion of the crystal lattice greater than 0.0002 A could be observed during such diffusion, and the broadening observed of X-ray diffraction spectra indicated no preferred crystallographic planes for the evolution of molecular hydrogen. Blisters were formed across the faces of single crystals of iron, when made a cathode, indicating that diffusion of hydrogen occurs through the crystal grains rather than along crystal boundaries. For palladium, an expansion was observed during actual electrolysis to an extent of 0.0170 ± 0.0002 A. On ceasing electrolysis, there was reversion to a less-expanded lattice of palladium hydride. Broadening of the reflections observed during electrolysis indicated no preferred planes for evolution of hydrogen. The significance of these findings is discussed for mechanisms of overvoltage and of diffusion of hydrogen through metals.

541.13

8310 ELECTRODE PROCESSES ON GERMANIUM IN SOLUTIONS OF SULPHURIC ACID IN THE PRESENCE OF OXIDIZING AGENTS.

E.N.Paleolog, A.Z.Fedotova and N.D.Tomashov.

Dokl. Akad. Nauk. SSSR, Vol. 129, No. 3, 623-6 (Nov. 21, 1959). In Russian.

The kinetics of electrode processes on Ge specimens of various conductivity types was studied in H_2SO_4 (pH 1.0), with H_2O_2 and Fe^{3+} added. The behaviour of the n-type Ge at the cathode was found to the the same as that of a metal electrode, the overpotential amounting to 1.2-1.3 V at 10 mA/cm^2. The oxidizing agents used are reduced on the n-type Ge. For the p-type Ge a supplementary inhibition (relating to the semiconductor properties) was observed, resulting in the increase of the slope of polarization curves and in the decrease of the "maximum" diffusion current (in the presence of the oxidizing agents).

F.Lachman

541.13

8311 CHARGING OF NICKEL FILMS WITH HYDROGEN EVOLVED ELECTROLYTICALLY IN THE PRESENCE OF CATALYTIC POISONS. B.Baranowski and M.Smialowski.

J. Phys. Chem. Solids, Vol. 12, No. 2, 206-7 (Jan., 1960).

Nickel coated copper wire was used as cathode in the electrolysis of 1N sulphuric acid containing 0.2g of thiourea/l. at a current density of 2×10^{-2} A/cm^2 and room temperature. The volume of hydrogen desorbed from specimens charged thus was taken as a measure of the absorption of electrolytically deposited hydrogen. For nickel films of a thickness of 0.7 to 30 μ a ratio of about 0.7 atoms of hydrogen to one atom of nickel was found. This is thought to be related to an average of 0.6 holes per nickel atom in the d-band of the metal, and to confirm the hypothesis of Mott and Jones concerning the filling of these holes by electrons from the hydrogen.

R.Schnurmann

541.13

8312 THE MECHANISM OF ELECTROLYTIC METAL DEPOSITION. B.E.Conway and J.O'M.Bockris.

Proc. Roy. Soc A, Vol. 248, 394-403 (Nov. 25, 1958).

Possible mechanisms of electrolytic metal deposition from aqueous solutions of cupric, nickelous and silver ions are examined by deriving and comparing the relevant potential energy profiles with the purpose of indicating the rate-determining step. The following steps in the overall reaction are considered: ionic transfer from the solution to surface sites; surface diffusion of adsorbed ions; successive dehydration of the adions at lattice building sites. The formation of adions and adatoms in intermediate steps is distinguished and it is shown that neutral adatom formation is unlikely. The heat of activation for transfer of ions from the solution to the metal surface, depends upon the site to which transfer occurs, that to a planar site being significantly less than that to other sites (e.g edges, kinks, etc) and has prohibitively high values for transfer to form adatoms. Lattice building is accomplished by surface diffusion of transferred adions to edges or kinks. At each of the consecutive stages of the deposition process, a change in hydration of the ion or adion occurs and has important effects on the mechanism and kinetics of deposition. Direct deposition of divalent ions on to surface sites is shown to be associated with high heats of activation and low electrochemical rate constants as found experimentally for Ni^{2+}, Fe^{2+} and Co^{2+} deposition. When the deposition reaction can occur through an intermediate redox step involving a stable ion as, e.g. in the case of copper, it is shown that lower free energies of activation can result than if the deposition of the divalent ion occurs in one step. This is consistent with the experimental behaviour found for copper deposition. At low overpotentials, it is shown that both the steps of ionic transfer and surface diffusion would have comparable rate constants in the case of copper and silver deposition whilst at higher overpotentials, the reduction of Cu^{2+} ions becomes rate determining at copper, whilst ionic transfer of Ag^+ ions becomes rate determining at silver. This is in agreement with the behaviour observed experimentally.

541.13

8313 QUANTUM MECHANICAL BASIS FOR THE TAFEL EQUATION. S.G.Christov.

Z. phys. Chem. (Leipzig), Vol. 212, No. 1-2, 40-54 (1959). In German.

The logarithmic increase of the electrolytic overpotential with current density as described by Tafel has been variously explained either as an indication of the recombination of the discharged ions or as the passage of the ions through the potential barrier of the Helmholtz double layer as the rate determining process. The quantum effects were shown to be important for the isotope separation in the electrolytic production of hydrogen. The validity of Tafel's equation was proved for all those cases in which the tunnel effect was comparatively small. On the other hand, the portion of the current which passes through the energy barrier depends upon the thickness of the barrier as well as upon its height. Both become smaller with an increase in overpotential, so that a larger proportion of the ions jumps over instead of passing through the barrier.

R.Schnurmann

PHOTOCHEMISTRY
RADIATION CHEMISTRY

541.14

8314 STEADY-STATE STUDIES BY E.P.R. ON THE PHOTO-DISSOCIATION OF SOME ALKYL HYDROPEROXIDES.

L.H.Piette and W.C.Landgraf.

J. chem. Phys., Vol. 32, No. 4, 1107-11 (April, 1960).

A new steady-state method for studying dynamic photochemical processes by e.p.r. is discussed. The e.p.r. spectra of some photolyzed alkyl hydroperoxides are obtained and the free radical intermediates identified as alkoxy radicals. Recombination rate constants of ~ 10^5 litre/mole sec were obtained with activation energies of ~ 4 kcal. A new e.p.r. spectrometer with improved sensitivity capable of photoirradiation in situ and variable temperatures is discussed.

541.14

8315 RATE CONSTANTS AT LOW CONCENTRATIONS. V. MECHANISM OF REACTION OF OZONE WITH PHOTOLYZING NITROGEN DIOXIDE IN PRESENCE OF EXCESS OXYGEN.

H.W.Ford, G.J.Doyle and N.Endow.
J. chem. Phys., Vol. 32, No. 4, 1256-7 (April, 1960).

For Pt IV see Abstr. 825 (1958). Trace concentrations of ozone and nitrogen dioxide in pure, dry air at atmospheric pressure were exposed to a known intensity of 3660 A radiation in a stirred flow reactor at 300°K. An increase of steady-state concentrations of ozone and nitrogen dioxide above their dark values were observed and measured. A value of $k_7K_{eq} = 0.44 \text{ sec}^{-1}$ ($NO_3 + NO \rightarrow 2NO_2$, k_7, $NO_2 + NO_3 \rightleftharpoons N_2O_5$, K_{eq}) was obtained from the data using a postulated mechanism. The good agreement between this value and the values of 1.0 sec^{-1} obtained by Hisatsune, Ogg and Crawford (1957) supports the validity of the proposed mechanism.

541.14

8316 THE POLYMERIZATION OF STYRENE SENSITIZED BY MOLECULES IN THE TRIPLET STATE. I. THE REACTION BETWEEN ANTHRACENE AND STYRENE.

V.S.Andersen and R.G.W.Norrish.
Proc. Roy. Soc. A, Vol. 251, 1-3 (May 12, 1959).

The photochemical reaction between anthracene and styrene has been investigated. It has been found that excited anthracene not only initiates the polymerization of styrene, but also copolymerizes with it. In view of the long life of the triplet state of anthracene as compared with that of the excited singlet state, it has been suggested that it is triplet anthracene which is involved in the reaction.

541.14

8317 THE POLYMERIZATION OF STYRENE SENSITIZED BY MOLECULES IN THE TRIPLET STATE. II. KINETICS AND MECHANISM.

R.G.W.Norrish and J.P.Simons.
Proc. Roy. Soc. A, Vol. 251, 4-26 (May 12, 1959).

The kinetics and mechanism of the reaction between anthracene and styrene have been fully investigated. By means of flash photolysis techniques, it has been confirmed that it is the triplet state of anthracene which sensitizes the polymerization. It has also been shown that both triplet and unexcited singlet anthracene copolymerize with styrene, the former with a zero activation energy. The work has been extended to the polymerizations sensitized by pyrene and chrysene, and to the unsensitized photopolymerization of styrene. It has been shown that in every case an initiation mechanism, involving the initial formation of a triplet-monomer complex, satisfactorily explains the observed results. The copolymerization rates of pyrene and chrysene were undetectable; these results, coupled with those obtained for the copolymerization of anthracene with styrene, are in agreement with the conclusions of Kooyman and Farenhorst, Szwarc, and others, concerning the reactivity of olefinic and aromatic hydrocarbons to radical addition. Finally, a qualitative investigationof the photochemical reactions between the sensitizers, and cumene and 9.10-dihydroanthracene, has been made.

541.14

8318 THE ABSORPTION SPECTRUM OF SO AND THE FLASH PHOTOLYSIS OF SULPHUR DIOXIDE AND SULPHUR TRIOXIDE.

R.G.W.Norrish and G.A.Oldershaw.
Proc. Roy. Soc. A, Vol. 249, 498-512 (Feb. 10, 1959).

The flash photolysis of sulphur dioxide under adiabatic conditions results in the complete temporary disappearance of its spectrum, which then slowly regains its original intensity over a period of several milliseconds. Simultaneously with the disappearance of the sulphur dioxide spectrum a continuous absorption appears in the far ultraviolet and fades slowly as the sulphur dioxide reappears. It is shown that the effect of the flash is thermal rather than photochemical, and the possibility of the existence of an isomer of sulphur dioxide at high temperatures is discussed; the disappearance of the normal spectrum on flashing is explained in this way. Several previously unrecorded bands of SO observed in the photolysis indicate that the vibrational numbering of its spectrum should be revised by the addition of 2 to the present values of v". This leads to a value of the dissociation energy of 123.5 kcal. Information about the levels v' = 4, 5 and 6 has also been obtained. The isothermal flash photolysis of sulphur trioxide results in the appearance of vibrationally excited SO, and the primary photochemical step in this reaction is discussed.

541.1

8319 STUDIES OF THE REACTIONS OF EXCITED OXYGEN ATOMS AND MOLECULES PRODUCED IN THE FLASH PHOTOLYSIS OF OZONE.

W.D.McGrath and R.G.W.Norrish.
Proc. Roy. Soc. A, Vol. 254, 317-26 (Feb. 23, 1960).

The photolytic decomposition of ozone has been further investigated using the technique of flash photolysis. Earlier results [Proc. Roy. Soc. A, Vol. 242, 265 (Mar. 5, 1957)], have been extended and a detailed mechanism for the production of vibrationally excited oxygen molecules put forward. Comparative studies of the decomposition with and without traces of water present have shown that the ^1D oxygen atom must be responsible for the chain reaction in both cases. When dry ozone is photolyzed under isothermal conditions, absorption due to vibrationally excited oxygen molecules in their electronic ground states is detected. These molecules are produced by the reaction $O + O_3 \rightarrow O_2^* + O_2$ with up to 17 quanta of vibrational energy, and are rotationally cold. When water is present however, no absorption due to O_2^* occurs but strong OH absorption is seen and it is shown that OH radicals are responsible for propagating the chain reaction in this case. These radicals can only be formed by the reaction $O(^1D) + H_2O \rightarrow 2OH + O_2$, leading to chain branching. It is an interesting observation that this reaction must be preferred to that with ozone stated above. Reactions of ^1D oxygen atoms with fluorine, chlorine, bromine and hydrogen have also been investigated.

541.14 : 539.2 : 535.3

PHOTOCHEMICAL BEHAVIOUR OF COMPLEXES CONTAINING OXYGEN IN ALKALI HALIDE CRYSTALS. See Abstr. 8009

541.15

8320 ELECTRON SPIN RESONANCE STUDIES OF THE OXYGEN EFFECT ON IRRADIATED POLYTETRAFLUOROETHYLENE.

T.Matsugashita and K.Shinohara.
J. chem. Phys., Vol. 32, No. 3, 954-5 (March, 1960).

The spectra observed when γ-irradiated P.T.F.E. is exposed to air indicate that at least two kinds of oxygenated radicals are formed. E.F.W.Seymour

541.15

8321 MASS SPECTROMETRIC STUDIES OF IONIC INTERMEDIATES IN THE ALPHA-PARTICLE RADIOLYSIS OF ETHYLENE.

C.E.Melton and P.S.Rudolph.
J. chem. Phys., Vol. 32, No. 4, 1128-31 (April, 1960).

Two techniques were used for the elucidation of ion—molecule reaction mechanisms in the alpha radiolysis of C_2H_4 in a new alpha-particle mass spectrometer. The corresponding variations in the percent of primary, secondary, and tertiary ions over a tenfold pressure range (to 0.1 mm) were used to postulate the reaction mechanisms. Mixtures of the C_2 hydrocarbons were employed to increase the relative concentrations of a specific reactant ion, thus independently confirming the postulated mechanisms. Polymeric ions as large as $C_5H_9^+$ were observed. Conclusions as to reaction mechanisms drawn from this study are compared to those drawn from the appearance potential technique used in the electron impact studies. Values of the rate constants are also compared for several secondary reactions.

541.15

8322 DISSOCIATION OF C_6H_5T FOLLOWING BETA DECAY.

T.A.Carlson.
J. chem. Phys., Vol. 32, No. 4, 1234-9 (April, 1960).

The relative abundance of the various charged fragments formed following beta decay of monotritiated benzene was measured with a specially designed mass spectrometer. In nearly every case the C—He bond was ruptured, the charge remaining with $C_6H_5^+$. In 28% of the events the $C_6H_5^+$ species were further excited to produce more than 30 different charged fragments. Comparison of this spectr with the electron impact data on benzene is made to arrive at an estimate of the energies involved in the initial excitation and the results are found to be in essential agreement with those of other tritiated hydrocarbons. The molecular excitation of benzene following beta decay is then shown to result probably from a sudden electronic perturbation following the formation of the doubly charged He^3 nucleus. Some results on the dependence of the collection efficiency of a given ion on its kinetic energy are also discussed.

DISPERSIONS . COLLOIDS ADSORPTION

541.18

8323 A GENERALIZED THEORY OF SEDIMENTATION.

A.D.Maude and R.L.Whitmore.

Brit. J. appl. Phys., Vol. 9, No. 12, 477-82 (Dec., 1958).

A theoretical relationship between the concentration and the sedimentation velocity of nonflocculated suspensions of particles is derived. It is shown that the settling velocity relative to that of a single particle in the suspension is $(1-c)^{\beta}$ where β is a function of particle shape, size distribution and Reynolds number and c is the volume of solid per unit volume of suspension. The expression is shown to satisfy the experimental results of other workers. An empirical relationship between β and the Reynolds' number is suggested.

541.18 : 532.1

INTERACTION BETWEEN TWO EQUAL-SIZED EQUAL-SETTLING SPHERES MOVING THROUGH A VISCOUS LIQUID. See Abstr. 6731

541.18

8324 DEPOSITION OF UNIPOLAR CHARGED AEROSOL PARTICLES BY MUTUAL REPULSION.

W.W.Foster.

Brit. J. appl. Phys., Vol. 10, No. 5, 206-13 (May, 1959).

A simple theory is developed. The application enables the average radius and the average charge of the particles to be determined from measurements of the mass of smoke deposited on metal surfaces and the charge given up by the particles. This new method offers a means of determining the rate of coagulation of unipolar charged aerosols. Experiments with wood smokes indicate that the simple theory of deposition is correct. The calculated average radius of the wood smoke particles examined compares favourably with that determined from measurement of the optical density and mass concentration of the smoke. The charge determined by the new method is consistent with that calculated on the bases of corona charging theory.

541.18

8325 COLLECTION OF GAS-BORNE DUST PARTICLES BY MEANS OF AN ASPIRATED SAMPLING NOZZLE.

S.Badzioch.

Brit. J. appl. Phys., Vol. 10, No. 1, 26-32 (Jan., 1959).

The efficiency is shown theoretically to depend on (a) the ratio of the velocity of aspiration into the sampling nozzle to the velocity of the undisturbed gas stream, and (b) the ratio of a length representing the distance of disturbance upstream of the nozzle to the "range" of a particle. The "range" is defined as the distance a particle would travel, before coming to rest, if projected into still gas with a velocity equal to that of the gas stream. In the range of conditions investigated experimentally, which included nozzles of 0.65 to 1.90 cm diameter aspirating from turbulent gas streams, it is found that the length representing the upstream disturbance is a function of the diameter of the nozzle.

541.18

8326 SOME STATISTICAL ASPECTS OF DUST COUNTING.

J.R.Ashford.

Brit. J. appl. Phys., Vol. 11, No. 1, 13-21 (Jan., 1960).

The application of statistical methods to the problem of evaluating samples of air-borne dust obtained with the thermal precipitator is discussed. A brief description is given of the nature of the dust sample, followed by an outline of the techniques employed to estimate the number of particles deposited. The three main sources of counting variation — systematic differences between observers, basic counting error and random distribution of particles in the dust deposit — are then considered. The effect of size distribution on counting errors is examined and it is shown that this factor may lead to appreciable variation in the recorded counts. Following a short description of various properties of the dust deposit which, although not strictly associated with the counting process, have a bearing on the reported concentration, recommendations are made about optimum procedures for counting thermal-precipitator samples.

541.18

8327 INTER-OBSERVER CHECKS ON STANDARDS OF PERFORMANCE IN EVALUATING THERMAL PRECIPITATOR SLIDES.

J.W.J.Fay, J.R.Ashford and P.H.Smith.

Brit. J. appl. Phys., Vol. 11, No. 3, 119-24 (March, 1960).

The problems associated with a monitoring procedure for maintaining satisfactory levels of counting thermal precipitator slides by members of a widely scattered team are discussed, with particular reference to the Pneumoconiosis Field Research of the National Coal Board. Experience within the research, since it started in 1953, is described and details are given of a new procedure based on a hierarchy, topped by a small number of "Master Counters", the mean of whose counting levels is taken as the standard of reference of the whole team. The results obtained are summarized and it is concluded that the method gives an adequate measure of control. Some improvements to be applied in future checks are mentioned.

541.18

8328 WAX-ATOMIZER FOR PRODUCING SPHERICAL DUST PARTICLES.

G.K.Greenough.

J. sci. Instrum., Vol. 37, No. 4, 123-4 (April, 1960).

An airblast atomizer is described which produces spherical wax particles suitable for use in the investigation of the aerodynamic behaviour of dust particles.

541.18

8329 IMPROVED SMOKE DENSITY RECORDER.

R.Lambie.

J. sci. Instrum., Vol. 37, No. 4, 144-6 (April, 1960).

A smoke-density recorder is described in which high stability is achieved by the use of stabilized circuits for the light source and head amplifier. A method of calibration by means of optical-density screens standardized for the type of photocell used is given. Drift caused by deposition of smoke on the optical system was overcome by the use of hot air jets. During extended tests on laboratory and industrial installations, stable operation with negligible drift was obtained.

541.18 : 532.5

ANALYSIS OF A POLYDISPERSE AQUEOUS SPRAY FROM A HIGH-SPEED SPINNING DISK ATOMIZER. See Abstr. 6755

541.18

8330 THE STUDY ON THE STRUCTURE OF FINELY DIVIDED SOLIDS BY X-RAY SMALL ANGLE SCATTERING. PARTICLE SIZE DETERMINATION OF SILICA GEL.

N.Kasai, M.Kakudo and T.Watase.

Technol. Rep. Osaka Univ., Vol. 8, 443-53 (Oct., 1958).

The influence of the packing density of a polydisperse colloidal system on the shape of the small-angle scattering curve was studied experimentally. The scattering curves of finely divided silica gel specimens were analysed by the methods of Porod (1955), of Jellinek and Fankuchen (1949), of Shull and Roess (1947), and of Hosemann (1950). For some specimens analysis due to absolute intensity measurement was also undertaken. The average particle size, the particle size distribution, the surface area, and other structural elements were estimated and the results were compared. For the dilute system, the values of mass-averaged particle size and the value of l_c of Porod's theory have the same magnitude.

541.18.

8331 SIMPLE ULTRAMICRO-PIPETTE FOR ELECTRON MICROSCOPY.

R.Hardy, J.R.Majer and S.Travers.

J. sci. Instrum., Vol. 37, No. 3, 103-6 (March, 1960).

A design for an ultramicro-pipette which permits the controlled delivery of droplets down to $2\ \mu$ in diameter is described. After measurement by means of a screw-micrometer eyepiece, the droplets are deposited directly upon film-covered electron-microscope grids by means of a micro-manipulator. This technique allows particle counts of suspensions of submicroscopic particles to be made with greatly increased precision.

541.18

8332 HYDROGEN ABSORPTION BY NICKEL ENRICHED ZIRCALOY-2.

W.Yeniscavich, R.A.Wolfe and R.M.Lieberman.

J. nuclear Mater., Vol. 1, No. 3, 271-80 (Oct., 1959).

Specimens of Zircaloy-2 with varying nickel contents were exposed to autoclave corrosion, and also simultaneous corrosion and reactor irradiation in a hot water loop. Increasing the nickel content of Zircaloy-2 (0.05 weight per cent Ni) to 0.75 weight per cent nickel caused a gross increase in hydrogen absorbtivity, which resulted in embrittlement and severe loss of mechanical strength.

541.18

8333 ION EXCHANGE AND THE THERMODYNAMICS OF INTRACRYSTALLINE SORPTION. I. ENERGETICS OF OCCLUSION OF ARGON AND NITROGEN BY FAUJASITE-TYPE CRYSTALS. R.M.Barrer and W.I.Stuart.

Proc. Roy. Soc. A, Vol. 249, 464-83 (Feb. 10, 1959).

The occlusion of argon and of nitrogen has been investigated in a variety of ion-exchanged, synthetic, faujasite-type crystals, over the temperature range 173 to 273° K and for amounts sorbed between 0 and 0.3 of saturation (A in Li-, Na-, K-, Ca-, Sr- and Ba-zeolite) and between 0 and 0.5 of saturation (N_2 in Li-, Na-, and K-zeolite). The behaviour observed depends both on the cation present in the crystal and upon the sorbate. In all cationic forms the affinities and heats of intercalation for nitrogen are considerably above those for argon. The crystals behave as energetically homogeneous sorbents for A in Na-, K- and Ba-forms, and for N_2 in the K-form. The heat of occlusion depends upon amount sorbed, to a greater or lesser degree, for A in Li-, Ca- and Sr-faujasites and for N in the Li- and Na-forms. Where energetic heterogeneity arises it is more noticeable in the case of nitrogen sorption. The isosteric heats of sorption of nitrogen are also distinguished from those of argon by showing considerable temperature coefficients. The data for both sorbates have been analysed in terms of dispersion, repulsion, polarization and quadrupole interactions, and the different behaviour of each sorbate interpreted.

541.18

8334 ION EXCHANGE AND THE THERMODYNAMICS OF INTRACRYSTALLINE SORPTION. II. ENTROPY OF OCCLUSION OF ARGON AND NITROGEN BY FAUJASITE-TYPE CRYSTALS. R.M.Barrer and W.I.Stuart.

Proc. Roy. Soc. A, Vol. 249, 484-97 (Feb. 10, 1959).

Partial molal entropies of argon and nitrogen have been determined in the temperature range 173 to 273° K for the systems argon in Li-, Na-, K-, Ca-, Sr- and Ba-faujasite and nitrogen in Li-, Na- and K-faujasite, over the degrees of saturation, θ, of the intracrystalline free volume of approximately $0 < \theta < 0.3$ for argon and $0 < \theta < 0.5$ for nitrogen. From these entropies the thermal entropies of the sorbates have been evaluated, and the degrees of freedom possessed by the sorbate estimated. Thus analyses for the same systems of heats of occlusion (Pt I) and of entropies of occlusion have been obtained. There are close parallels in behaviour which have received a logical explanation. For those systems which exhibit energetic homogeneity (A in Na-, K- and Ba-faujasite and N_2 in K-faujasite) the entropy data indicate substantial intracrystalline mobility. When the systems exhibit energetic heterogeneity, this is associated with the presence of cations of high polarizing power and smaller ionic radius, but not all the cations of a given kind contribute equally to the effects observed. Accordingly, the energetic heterogeneity tends to disappear rather rapidly with increasing charge of gas, while at the same time the thermal entropy rises. This change in thermal entropy has been interpreted as due to increased rotational freedom (N_2) and to increased amplitudes of vibration (N_2 and A) as molecules become increasingly located in less energetically sorbing regions of the intracrystalline capillary system.

541.18

8335 ADSORPTION AND OXIDE FORMATION ON ALUMINIUM FILMS. D.D.Eley and P.R.Wilkinson.

Proc. Roy. Soc. A, Vol. 254, 327-42 (Feb. 23, 1960).

Type I aluminium films deposited at 0° C were of relatively low area, ~1000 cm², stable and with a certain porosity since CO uptake was proportional to film weight. Thus a film area could be determined from its weight, since at saturation CO molecules occupy 0.75 of the total surface area given by the B.E.T. method (established for higher area type II films). It was found that H_2 and N_2 were not chemisorbed, N_2O and NO reacted giving surface oxide, C_2H_4 gave a slow reversible adsorption, and CO gave a slow irreversible adsorption, rate proportional to p/g, where p is the gas pressure, g the quantity of gas taken up by the film. The kinetics of oxygen uptake were followed in the range 10^{-2} to 10^{-3} mm Hg pressure. The first two monolayers were taken up too rapidly for kinetic measurement, and thereafter gas uptake followed the direct logarithmic law, until about 7 A of film had been formed

$$dg/dt = a\, e^{-\gamma g/RT}\, p^{0.6},$$

where a and γ are constants. The rate-determining step is considered to be a place exchange of surface oxygen with underlying atoms, stimulated by reversibly chemisorbed oxygen atoms. As the film thickens it changes from covalent amorphous to ionic spinel character, and the activation energy for place exchange increases. The process of film growth in the ionic film (thickness $> \sim 10$ A) involves electron tunnelling and cation migration.

541.18 : 539.21'

A RAPID DETERMINATION OF SOME SURFACE PROPERTIES OF SOLIDS BY HEAT OF ADSORPTION MEASUREMENTS.

See Abstr. 8264

541.18 : 532.6

8336 THE PENETRATION OF LIQUIDS IN ABSORBENT SOLIDS. F.H.Constable and D.N.Constable.

Rev. Fac. Sci. Univ. Istanbul C, Vol. 23, No. 3-4, 247-72 (July-Oct., 1959).

For the rise of a liquid in Watman 31 filter paper, the following equation was found to apply:

$$\log_e \frac{h_\infty}{h_\infty - h} - h/h_\infty = kt,$$

where h_∞ is the equilibrium height of the liquid, h the height at time t, and k is a constant varying with the liquid and the temperature. The constant k is roughly related to $\rho^2/\sigma\eta$, but with considerable variation. Similarly, h_∞ is roughly proportional to σ/ρ. This shows that the filter paper behaves differently with different liquids, and examination of the expression shows that if the effective values of the radius of the capillaries carrying the liquid are related to height (h) by $r = \sigma(\rho g h)^{-1}$, then the velocity of the rise is a maximum and there is no limit to the height of rise, and a cube law should exist giving

$$h = A(t^{1/3} - B).$$

For all the liquids tested, the formula described the height for one half of the rise very accurately The correction B modifies the first minute. The later deviation corresponds to the absence of sufficiently fine capillaries to keep the liquid rising and so a terminal height is attained. The constant A is much more precisely calculable than κ, and is shown to be proportional to $(\sigma^2/\eta\rho)^{1/3}$ for the series of liquids tested.

541.18

8337 THE RELATION BETWEEN THE CUBE ROOT AND LOGARITHMIC LAWS FOR THE PENETRATION OF LIQUIDS INTO POROUS SOLIDS. F.H.Constable and D.N.Constable.

Rev. Fac. Sci. Univ. Istanbul C, Vol. 23, No. 3-4, 273-9 (July-Oct., 1959).

From the theoretical relation

$$-\log_e(1 - x) - x = kt$$

where $x = h/h_\infty$, for the creep of liquids upwards in porous solids, the relation

$$h = A(t^{1/3} - B)$$

is deduced as the line passing through the inflection of the h and $t^{1/3}$ curve. The values of the constants A and B are deduced in terms of h_∞ and k and compared with the experimental results. The form of the law is found to be correct, but the results are best expressed for Watman 31 paper by A = 0.862 and B = 0.0572, compared with the theoretical values A = 0.903 and B = 0.0252.

PHYSICAL METHODS OF CHEMICAL ANALYSIS

545 : 535.33

8338 THE STANDARD ADDITION TECHNIQUE IN FLAME SPECTROMETRY. T.E.Beukelman and S.S.Lord, Jr.

Appl. Spectrosc., Vol. 14, No. 1, 12-17 (1960).

The standard addition—logarithmic extrapolation technique has been successfully applied to flame spectrometric analyses. The use of this method makes possible the determination of trace metals in samples without extensive calibration or in standards which have undefined matrices. The mathematical theory of the method has been extended to allow the calculation of the optimum addition sizes and the magnitude of the extrapolation errors. Normally three additions which are equal to, twice, and four times the original amount are optimum. Under these conditions the relative error caused by extrapolation is approximately seven times the relative error in the original intensity measurements. Thus, if the errors in the intensity measurements are ±0.5%, the error in the analysis will e of the order of 4%. The utility of the method has been demonstraed in the difficult determination of calcium in the presence of hosphate and the determination of calcium and sodium in a highly iscous organic liquid.

545

8339 MUTUAL INFLUENCES IN THE SPECTROGRAPHY OF SOLUTIONS OF Fe, Ni, Cr AND Ti, TAKEN TWO AT A TIME. G.Baudin and G.Hénon.

C.R.Acad. Sci. (Paris), Vol. 250, No. 8, 1463-5 (Feb. 22, 1960).
In French.

Addition of an element B to a solution of an element A causes an apparent change in the concentration of A which, for small concentration of B ($\leq 2500\ \mu g\ cm^{-3}$) is proportional to the concentration of A. These results are interesting for the analysis of stainless steels. G.F.Lothian

545

8340 IONIZATION DETECTOR FOR GASES AND VAPORS. L.E.Maley.

3rd National Conference on Analog and Digital Instrumentation. New York: The American Institute of Electrical Engineers (March, 1959) p. 196-201.

An ionization chamber consists of a stainless steel cylindrical outer electrode 10 cm long by 2 cm in diameter with 50 to 100 μg of radium distributed over its inside surface and a central inner wire electrode. Two such chambers are connected in a bridge circuit and the gas to be sampled is drawn through both tubes. Before reaching one of the tubes, however, it is treated by pyrolysis, by a chemical reagent, or other means to form a smoke. Small quantities of impurities can thus be detected; examples of ranges for which the analyser has been calibrated are; 0-100 parts in 10^9 nickel carbonyl; 0-50 parts in 10^9 HCl; 0-5 parts in 10^6 HF; 0-5 parts in 10^6 SO_2; and 0-5 parts in 10^6 CCl_4, all as impurities in air. G.A.Montgomerie

545

8341 SENSITIVE THERMAL CONDUCTIVITY GAS ANALYZER. J.R.Purcell and R.N.Keeler.

Rev. sci. Instrum., Vol. 31, No. 3, 304-6 (March, 1960).

A thermal conductivity gas analyser has been designed using a.c. excitation for the thermal conductivity cell. This has greatly reduced drift and has increased sensitivity. The unit has a minimum range of 200 p.p.m. N_2 in H_2 for full scale deflection.

545

8342 SUMMARIZED PROCEEDINGS OF A COLLOQUIUM ON X-RAY FLUORESCENCE ANALYSIS — LONDON, FEBRUARY AND APRIL, 1958. F.W.J.Garton and H.M.Davis.

Brit. J. appl. Phys., Vol. 10, No. 3, 105-16 (March, 1959).

545

8343 X-RAY FLUORESCENCE ANALYSIS WITH A NUCLEAR SOURCE OF PRIMARY IRRADIATION.

K.I.Narbutt, R.L.Barinskii and I.S.Smirnova.
Dokl. Akad. Nauk SSSR, Vol. 130, No. 2, 291-4 (Jan. 11, 1960).
In Russian.

Describes an apparatus for X-ray fluorescence analysis using a radioactive source, thulium 170, in the place of the usual X-ray tube. The range of elements that can be excited is Zn(30) to U(92) inclusive. A scintillation counter with a sodium iodide crystal is used as a spectrometer. In spite of the poor resolution compared with a crystal spectrometer, the equipment can be used in many analytical problems. An example is given of the determination of the rare earth content of several mineral specimens. T.Mulvey

545

8344 ANALYSIS OF THE LIGHTER ELEMENTS BY TOTAL REFLEXION OF THEIR CHARACTERISTIC X-RAY WAVELENGTHS. A.Franks and R.F.Braybrook.

Brit. J. appl. Phys., Vol. 10, No. 4, 190-1 (April, 1959).

The analysis of characteristic X-ray wavelengths in the region of 10 A has been achieved by a technique employing total external reflection.

545

8345 ELECTRON PROBE METHODS OF X-RAY MICRO-ANALYSIS. P.Duncumb.

Brit. J. appl. Phys., Vol. 11, No. 5, 169-76 (May, 1960).

The use of an electron probe to produce a point source of X-rays permits chemical analysis, by X-ray absorption or fluorescence spectroscopy, of regions down to 1 to 10 μ in diameter. For the study of surfaces, the emission method, in which the probe excites the specimen itself, is more suitable; this gives a resolving power of about 1 μ and a detection sensitivity of 10^{-14} g. By means of a scanning technique, an image of the surface can be formed with a selected emission line, so that the distribution of a particular element is presented visually. The three methods are described with typical applications and are shown to be in many respects complementary.

GEOPHYSICS

550.3

8346 TESTS OF AN AIRBORNE GRAVITY METER. L.L.Nettleton, L.LaCoste and J.C.Harrison.

Geophysics, Vol. 25, No. 1, 181-202 (Feb., 1960).

Gravity measurements have been made in an airplane, and a contour map using 20 mg intervals constructed for 12 000 ft elevation. A LaCoste–Romberg instrument was used. The meter was installed in a B-17 aircraft equipped with a precision radar altimeter, and aerial mapping cameras for the accurate navigation needed for determination of the centrifugal (Eötvös) and elevation corrections. A series of nine lines over the Imperial Valley (California) gave results believed to be accurate to about 10 mg or better as indicated by (1) the general consistency of the contour map and its similarity to a free air gravity map drawn from ground data, (2) repeat observations over almost the same courses, (3) agreement of independent values at line crossings (with Eötvös correction differences of as much as 2000 mg), and (4) agreement with values calculated from ground gravity stations. Short period disturbances due to accelerations of the airplane are averaged over a certain time interval. This results in an "uncertainty principle", in that the accuracy of observation increases as this time interval is lengthened, but details of the gravity variation are lost due to the increased distance travelled during each measurement. The values reported are for an averaging time of approximately three minutes corresponding to a travel distance of about ten miles. The quality of the results is adequate for geodetic purposes and possibly for certain regional geophysical problems.

550.3

8347 THE EXTERNAL GRAVITY FIELD OF A ROTATING SPHEROID TO THE ORDER OF e^3. A.H.Cook.

Geophys. J., Vol. 2, No. 3, 199-214 (Sept., 1959).

The theory of the external gravity field of a rotating body bounded by a spheroidal equipotential surface is carried to terms of the order of e^3. The potential is expanded in functions that are orthogonal in the space outside an oblate spheroid. It is found that terms of order e^3 in the gravity formula and in the relation between J, e and m are mostly very small.

550.3 : 539.4

MINERAL FORMATION : FAULTS IN MATERIALS THAT HARDEN WHEN THEY YIELD. See Abstr. 8125

550.3

8348 ON THE DAMPING OF GRAVITY WAVES PROPAGATED OVER A PERMEABLE SURFACE. J.N.Hunt.

J. geophys. Res., Vol. 64, No. 4, 437-42 (April, 1959).

The problem of the damping of small amplitude gravity waves propagated over a permeable sea bed is examined in terms of viscous-flow theory. Previous solutions for the exponential loss of wave height with distance consider either viscous damping over an impermeable bed, for example, Biesel (1949), or inviscid potential flow over a permeable bed, Reid and Kajiura (1957). A solution is obtained which satisfies the full viscous boundary conditions, and for small values of the viscosity and permeability the damping is found to be the sum of these two solutions. This result agrees reasonably well with measurements by Savage (1953) on waves over a smooth sand bed. It is also found that to a first approximation viscosity slightly lengthens the classical free-wave period in shallow water, while permeability does not.

550.3 : 534.2

8349 MODES, RAYS, AND TRAVEL TIMES. I.Tolstoy.
J. geophys. Res., Vol. 64, No. 7, 815-21 (July, 1959).

Relationships between the normal-mode and the ray-optical interpretations of seismic and acoustic measurements are discussed, and applications to the theory and practice of refraction techniques are given. The validity of the ray theory is sometimes open to question; that is, the results of travel-time and intercept measurements may be subjected to overinterpretation in terms of rays. Several questions of principle are examined in this connection. It is emphasized that the idea of mode cannot be brought into direct correspondence with the rays and travel times of the optical, approximate approach, and efforts to interpret mode behaviour in terms of rays can lead to paradoxical conclusions. This can be understood in terms of the plane-wave, asymptotic nature of such concepts as phase and group velocity.

550.3 : 518 : 621.317.76

8350 PHOTOMECHANICAL METHOD OF FREQUENCY ANALYSIS OF SEISMIC PULSES.
B.F.Howell, Jr, A.B.Andrews and R.E.Huber.
Geophysics, Vol. 24, No. 4, 692-705 (Oct., 1959).

The harmonic analysis of a seismic pulse performed by a photomechanical wave analyser is analytically related to the Fourier integral analysis of this aperiodic pulse. The calculated integral spectra of three simple analytical pulses are compared with the spectra obtained from this analyser. The integral analyses of two siesmic pulses are compared with the harmonics obtained through numerical analysis. The frequency range of the integral analysis which can be performed by this analyser is from 5 to 300 c/s. Integral analyses of recorded seismic pulses up to 6 in. long (0.10 sec) and with peak amplitudes up to 0.69 in. can be performed. From an evaluation of the equipment and operational errors involved in the measurements, the integral approximations obtained from the analyser are estimated to be accurate on the average to within 1 dB in the frequency range from 5 to 100 c/s. For frequencies greater than 100 c/s, this accuracy will decrease. This is as great an accuracy as is usually obtained by numerical analysis.

550.3 : 621.317.39

8351 CONTINUOUS SIGNAL SEISMOGRAPH.
J.M.Crawford, W.E.N.Doty and M.R.Lee.
Geophysics, Vol. 25, No. 1, 95-105 (Feb., 1960).

Describes a method in which a continuous signal vibrator provides the source energy. Operational features, as well as some general theoretical considerations, are discussed.

550.3 : 621.372.543.2

8352 ELIMINATION OF SEISMIC GHOST REFLECTIONS BY MEANS OF A LINEAR FILTER. J.P.Lindsey.
Geophysics, Vol. 25, No. 1, 130-40 (Feb., 1960).

A technique is described for the elimination of ghost reflections on magnetically recorded seismograph records by means of a linear filter. The application of this filter does not alter the character of primary reflections although eliminating the ghost reflections. The principal assumption made in the development of the technique is that the effect of a.g.c. in altering the amplitude ratio of primary and ghost reflections is uniform for all record time. A realization of the required filter is given and a measurement technique is outlined for detecting the existence of ghost reflections based on the outocorrelation function of the seismograph trace.

550.3 : 532.5

OFF-SHORE SEISMIC RECORDS. WAVE PROPAGATION IN WATER. See Abstr. 6764

550.3

8353 AN EQUATION OF STATE FOR THE CORE OF THE EARTH. L.Knopoff and G.J.F.MacDonald.
Geophys. J., Vol. 3, No. 1, 68-77 (March, 1960).

Recent shock wave measurements upon the compressibility of iron and eight other metals, at pressures up to five megabars, permit an investigation of the equation of state of the earth's core. The density of iron at T = 0 at 1.4 megabars (core--mantle boundary pressure) is 11.8. The density at the core boundary is estimated to be between 9.1 and 10.1, depending upon the particular earth model. The temperature correction is small. The discrepancy can only be resolved by stating that the core is not pure iron, but rather that it contains significant amounts of alloying elements of lower atomic number than iron. The seismic velocity in pure iron at core pressu is also significantly different from the velocity in the core and also indicates the existence of lighter components within the core. A material of mean atomic number 23 in the core is consistent with th shock wave velocity and density measurements and with seismic observations.

550.3

8354 TEMPERATURES WITHIN THE EARTH'S CORE. J.A.Jacobs.
Nature (London), Vol. 185, 521-2 (Feb. 20, 1960).

The author re-evaluates former work, considering recent data for the fusion curve of iron up to pressures of 96 000 atm.

E.G.Knowles

550.3 : 523.74 : 551.5

GEOMAGNETIC, AURORAL, IONOSPHERIC, AND COSMIC RAY PERTURBATIONS: INTERDEPENDENCE AND RELATION TO SOLAR ACTIVITY. See Abstr. 6442-3.

550.3

8355 SOME RESULTS OF INVESTIGATION OF MAGNETIC PROPERTIES OF ROCKS AND GEOLOGICAL BODIES.
A.G.Kalashnikov.
Ann. Geophys., Vol. 15, No. 1, 67-74 (Jan. - March, 1959).

A series of experiments on the nature of the magnetisation of regularly shaped rock specimens is described. It is found that prism of natural, outwardly homogeneous magnetite as well as prisms mad from mixtures of clay and magnetite exhibit differences in the homogeneity of magnetisation dependent on the method of magnetization used. An interpretation of the phenomenon is given, and the bearing on it of geological dynamics discussed.

S.J.St-Lorant

550.3

8356 RELATION OF FIRST IMPULSES IN HORIZONTAL AND VERTICAL MAGNETOGRAMS AT ALIBAG (BOMBAY).
S.L.Malurkar.
Acta phys Hungar., Vol. 8, No. 3, 359-60 (1958).

This is $-\Delta V = 14.84\ (1 - 10/\Delta H)$ where ΔV and ΔH are the initial vertical and horizontal impulses. It is a statistical relation for the period 1911-34.

J.M.Hough

550.3

8357 THE PROPAGATION OF WORLD-WIDE SUDDEN COMMENCEMENTS OF MAGNETIC STORMS.
V.B.Gerard.
J. geophys. Res., Vol. 64, No. 6, 593-6 (June, 1959).

A study of the times of three sudden commencements, recorded on August 3, September 21, and November 6, 1957, respectively, at ten widely-separated magnetic observatories, indicates that when main and preliminary impulses are both recorded at one place (as in the typical SC*) they really begin approximately simultaneously. Therefore, it would appear that in nontropical regions the rate of growth of the so-called preliminary impulse is usually greater than that of the main impulse, so that the latter is obscured until the former begins to decay. Differences around the earth between recorded times of the first impulse, whether the sudden commencement is an SC or SC* type, are only a few seconds, and the evidence suggests that the position of the sun controls the hemisphere in which the sudden commencement first occurs. This finding is interpreted in terms of the Singer shock-wave theory to mean that, as would be expected, the shock wave enters the auroral zone nearest the sun first and produces the sudden commencement a few seconds earlier in that hemisphere. At the equinox the sudden commencement times are roughly symmetrically distributed with respect to the geomagnetic equator.

550.3

8358 THE GEOMETRY OF THE EARTH'S MAGNETIC FIELD AT IONOSPHERIC HEIGHTS. G.H.Millman.
J. geophys. Res., Vol. 64, No. 7, 717-26 (July, 1959).

Discusses the geometry of radio-wave propagation associated with the earth's magnetic field. A theoretical method is presented which can be used to determine the angle that the earth's magnetic field makes with the direction of propagation, irrespective of geographic location and for transmissions directed at any azimuth and elevation orientation. The techniques of matrix-coordinate transformations are utilized in this analysis by assuming that the earth's magnetic field can be approximated by a centred magnetic dipole. Computations are given for one location in the Northern Hemisphere. The resultant data are compared with those obtained by the well-known graphical method in which ground-observed magnetic data are scaled from isomagnetic maps.

550.3 : 538.3

LOW-FREQUENCY ELECTROMAGNETIC RESPONSE OF SIMPLE CONDUCTING BODIES TO AN OSCILLATING MAGNETIC DIPOLE. See Abstr. 7201

550.3

8359 ON THE ORIGIN OF THE LONG-LIVED SOLAR CORPUSCULAR STREAMS WHICH APPEARED DURING THE LAST SOLAR CYCLE 1950-53. K.Sinno.

J. atmos. terrest. Phys., Vol. 15, No. 1-2, 151-5 (Sept., 1959).

It is well known that the geomagnetic variation shows a marked 27-day recurrence tendency, especially when the solar activity is on the decrease. In the decreasing epoch of solar activity (1949-1954), the remarkable recurrences of the geomagnetic variation developed without exception. The author verified through investigation by the Bartels' 27-day diagram that the vernal and autumnal maxima belonged to different series of the recurrences which appeared alternately in this period. For explanation of the above phenomena, the correlations between geomagnetic activities and solar coronal intensities are examined. It is concluded that the heliographic latitude of coronal intensity and the geomagnetic variation play an important role in these correlations. The corona directed to the earth (e.g. the northern corona in autumn when the earth comes to the north of the heliographic equator and the southern corona in spring when the earth comes to the south of the heliographic equator) shows a remarkable negative correlation with the geomagnetic variation. And the position, from, and speed of the corpuscular stream which affects the geomagnetic variation are discussed from the standpoint of inter-correlations with the geomagnetic variation.

550.3 : 551.5

STUDY OF THE EQUATORIAL ELECTROJET. I. AN EXPERIMENTAL STUDY. See Abstr. 6444.

550.3 : 551.5

STUDY OF THE EQUATORIAL ELECTROJET. II. A MODEL ELECTROJET THAT FITS H-OBSERVATIONS. See Abstr. 6445.

550.3 : 621.391.826

8360 RADIO ECHOES OBSERVED OVER THE SURFACE OF THE SEA AT THE IONOSPHERE SOUNDING STATION OF CASABLANCA. A.Haubert.

Ann. Geophys., Vol. 14, No. 3, 368-72 (July-Sept., 1958). In French.

The observed characteristics of certain radio echoes observed at Casablanca suggest that the reflection occurs from the surface of the sea. The results are consistent with the theory of a Doppler effect due to the motion of the sea waves. This should enable the measurement of the periods and lengths of sea waves to be made as far as 100 km using suitably modified ionospheric sounders.

C.Hazard

550.9

8361 POTASSIUM—ARGON AGE OF TEKTITES. W.Gentner and J.Zähringer.

Z. Naturforsch., Vol. 15a, No. 2, 93-9 (Feb., 1960). In German.

For previous work, see Abstr. 12890 (1959). The K-A ages of Bediasites and Moldavites were measured to be 29.4 and 8.7×10^6 years, while tektites from different localities between Indochina and Australia gave, within the experimental error, concordant ages of 610 000 years. These results agree with the ages of the formations on which tektites have lain. The contribution of this work to theories of the origin of tektites is discussed.

551.3 : 539.2

8362 DENSITY OF GLACIER ICE. P.A.Shumskiy.

J. Glaciol, Vol. 3, 568-73 (March, 1960).

See also Abstr. 13966 (1959). The density of glacier ice containing a given amount of air can be computed if it is assumed that both ice and air are subjected to a pressure due to the weight of overlying material. In this way it is possible to deduce the form that a curve of density versus depth should have for ice of a constant air content. Reasons for the divergence of observed depth-density profiles from those predicted by this theory are discussed, in particular the effect of the plastic-viscous behaviour of ice, which results in an air pressure differing from the hydrostatic pressure of the ice above. The empirical power-law relation between depth and density is discussed in the light of this theory, and is also used to derive relations for useful parameters characterizing the densification process such as rate of subsidence and rate of densification in terms of the depth, accumulation, and the constants entering the power law.

ATMOSPHERE . IONOSPHERE

(Abstracts on radiowave propagation in ionized media will also be found under Electromagnetic Waves)

551.5

8363 COEFFICIENTS FOR THE RAPID REDUCTION OF h'—f RECORDS TO N—h PROFILES WITHOUT COMPUTING AIDS. E.R.Schmerling and C.A.Ventrice.

J. atmos. terrest. Phys., Vol. 14, No. 3-4, 249-61 (June, 1959).

Tables of coefficients are presented by means of which h'—f records may be readily reduced to electron-density-height profiles without the use of computing aids. The tables presented are for any station whose magnetic dip angle does not exceed 80°. The ordinary ray trace is utilized. No special assumptions concerning profile shapes are made. Account is taken of the earth's magnetic field, but collisions are neglected. The sensitivity of these coefficients to magnetic dip angle and gyrofrequency is discussed. Sample h'—f records are reduced by means of the coefficients and the results are compared with those from the Budden matrix method.

551.5 : 621.391.812.624

8364 TROPOSPHERIC SCATTER PROPAGATION AND ATMOSPHERIC CIRCULATIONS.

W.F.Moler and D.B.Holden.

J. Res. Nat. Bur. Stand., Vol. 64D, No. 1, 81-93 (Jan.-Feb., 1960).

Transhorizon v.h.f. and u.h.f. fields exhibit deep fades or large signal enhancements of several hours' duration, as the propagation mechanism alternates between partial reflection and scattering caused by turbulent dielectric fluctuations in the atmosphere. Such alternations occur when strong refractive layers develop below 3000 ft. Surface-wind streamline analyses show that mesoscale centres of convergence or divergence cause local redistribution of refractive layering, tending to produce the change from one mechanism to the other. Current scattering theory and the empirical findings of others are examined to determine the gross meteorological factors that influence changes in scattered fields. The two variables in the turbulent scattering coefficients, the scattering angle and the intensity of dielectric fluctuations at high wave numbers, are found to be dependent upon the refractive layering and the thermal stability of the airmass. It has been shown elsewhere that refractivity and stability are principally functions of the vertical velocity in the atmosphere. It is shown here that the direction and relative magnitude of the vertical velocity can be inferred from the upper-tropospheric wind velocity divergence. Received scattered signals are found to be well correlated with computed velocity divergence. It is suggested that the variations of scattered signal level or range can be predicted in a routine manner by regular meteorological personnel using ordinarily available meteorological data.

551.5

8365 NEW METHOD FOR THE STUDY OF SOLID PARTICLES IN THE STRATOSPHERE. R.Challande and B.David.

C.R. Acad. Sci. (Paris), Vol. 250, No. 8, 1520-1 (Feb. 22, 1960). In French.

A new method is described by which microscopic and submicroscopic particles can be collected simultaneously in the same apparatus. They make use of the properties of an ionising electric field, in the environment of rarefied air in the stratosphere. An experiment based on the principle, operated according to the constructors design during a balloon flight to an altitude of about 15 000 m.

H.J.A.Chivers

551.5

8366 A PRELIMINARY MODEL ATMOSPHERE BASED ON ROCKET AND SATELLITE DATA. H.K.Kallmann.

J. geophys. Res., Vol. 64, No. 6, 615-23 (June, 1959).

The scientific results obtained from rocket and satellite observations have been studied in order to determine the physical properties of the atmosphere at high altitudes. A preliminary model atmosphere is presented for the region between 100 and 800 km. Numerical tables of density, pressure, and scale height as functions of altitude are given. Due to solar effects these physical parameters may vary from day to night and from latitude to latitude. However, preliminary studies have indicated that average densities and pressures might vary by at most a factor of two, the variations being larger at high than at medium latitudes. Densities presented by Russian scientists, which were also obtained from rocket and satellite data, agree with the model density presented here reasonably well. The densities derived by American and Russian scientists from satellite observations agree within less than a factor of two. The densities derived from rocket data are lower than the ones derived from satellite data for the same altitude. The maximum difference between the densities derived by Michnevich (1958) from rocket data and the average densities presented here occur around 150 km, where the values differ by a factor of 3.8; above and below these altitudes the differences are much less. It is estimated that these differences are within the limits of the variations to be expected and also within the limits of the uncertainties of the experimental data available at present.

551.5

8367 WINDS IN THE UPPER ATMOSPHERE.

W.G.Elford.

J. atmos. terrest. Phys., Vol. 15, No. 1-2, 132-6 (Sept., 1959).

A systematic investigation of winds in the upper atmosphere by the radio observation of drifting meteor trails has been in progress at Adelaide since 1952. These observations have revealed the presence of regular but complex wind systems in that portion of the atmosphere between 75 and 105 km above the ground. The line-of-sight speeds of drift of meteor trails are recorded automatically by means of a combined continuous wave and pulse system operating on a frequency of 27 Mc/s (Robertson et al.; Elford and Robertson, Abstr. 6170 of 1954). To determine the average monthly diurnal wind behaviour, the data for two weeks continuous observations are first divided into three height groups, each of 10 km interval. All measurements which occur in the same hourly interval of local time are then grouped together and the most probable wind vector for this hour is calculated by a least squares analysis. It is found that the calculated wind vectors are effectively horizontal.

551.5 : 533.6

TURBULENT TRANSFER IN THE BOUNDARY LAYER OF A STRATIFIED FLUID. See Abstr. 6827

551.5

8368 LARGE SCALE IRREGULARITIES IN HIGH ALTITUDE WINDS.

J.S.Greenhow and E.L.Neufeld.

Proc. Phys. Soc., Vol. 75, Pt 2, 228-34 (Feb., 1960).

Large-scale irregularities in the wind at heights of 80 to 100 km are discussed. Measurements of the wind at different heights using radio echoes from meteor trails show the presence of irregularities with a depth of about 10 km and a horizontal extent of over 100 km. These are identified with the large eddies detected using a two-station wind measuring system described in an earlier paper (Abstr. 4788 of 1960). The lifetimes of these large irregularities, given by auto-correlation curves derived from the time variation of the turbulent wind component, is found to be about 1.5 hr. Slow variations in the prevailing wind with periods of several days, produced by pressure systems similar in dimensions to the pressure systems at the earth's surface, are also observed in this region.

551.5 : 538.3

8369 GLOBAL HYDROMAGNETIC WAVE DUCTS IN THE EXOSPHERE.

H.A.Bomke, W.J.Ramm, S.Goldblatt and V.Klemas.

Nature (London), Vol. 185, 299-300 (Jan. 30, 1960).

Large wire loops (about 100 km^2 area) have been used in an experiment to detect earth-magnetic field perturbations. Two widely spaced stations have been set up, and have recorded effects due to high altitude nuclear detonations. Both stations recorded two signals; one indicating a travel time of about 5 sec, and the other was delayed by 20 sec. The authors conclude from this and other information that if the signals were caused by propagated hydromagnetic waves, then (1) waves at high altitudes are confined in ducts which are approximately concentric shells about the earth, (2) the waves travel along great circle paths, and (3) the propagation modes are the transverse and longitudinal hydromagnetic wave modes.

H.J.A.Chivers

551.5 : 538

8370 MAGNETO-HYDRODYNAMIC WAVES IN THE IONOSPHERE.

S.Akasofu.

J. atmos. terrest. Phys., Vol. 15, No. 1-2, 156-60 (Sept., 1959).

The study is made of the magneto-hydrodynamic waves in the ionosphere and the outer atmosphere. The dispersion relations of Alfvén waves are obtained and it is shown that various types of geomagnetic micropulsations and ionospheric noises appear in the wide range from audio- to very low-frequency. The Alfvén waves with finite amplitude are also studied. It is suggested that the retarded sound-type shock wave may be identified with the descendi "cusps" on h'-f curve of ionogram.

551.

8371 UPPER ATMOSPHERE DENSITY VARIATIONS DUE T HYDROMAGNETIC HEATING.

A.J.Dessler.

Nature (London), Vol. 184, 261-2 (July 25, 1959).

It is suggested that the solar wind interacting with the geomagnetic field generates hydromagnetic waves which are dissipated in the F1 region of the ionosphere, thereby heating it, increasing the atmospheric scale height, and hence increasing the density at high altitudes. This can explain (1) the observed correlation betwee solar radio noise intensity and the orbital deceleration of artificial satellites; (2) the sudden loss of trapped electrons from the Argus nuclear explosion during a magnetic storm; and (3) the increased X-radiation observed at balloon altitudes during a magnetic storm.

O.Penrose

551.5

8372 VARIATION OF UPPER ATMOSPHERE DENSITY WITH LATITUDE AND SEASON: FURTHER EVIDENCE FROM SATELLITE ORBITS.

D.G.King-Hele and D.M.C.Walker.

Nature (London), Vol. 185, 727-9 (March 12, 1960).

Calculations of air density from the orbital data of the satellites Discoverer 6 and Sputnik 3 rocket are presented. Comparing the information with that from other satellite observations, it appears that solar disturbances are the main factor influencing air density at heights of 200-300 km. Day to night changes and variations with latitude and season, are small.

H.J.A.Chivers

551.5

8373 THE ION-TRAP RESULTS IN "EXPLORATION OF THE UPPER ATMOSPHERE WITH THE HELP OF THE THIRD SOVIET SPUTNIK".

E.C.Whipple, Jr.

Proc. Inst. Radio Engrs, Vol. 47, No. 11, 2023-4 (Nov., 1959).

The results deduced from the data quoted by Krassovsky (Abstr. 7669 of 1959) depend upon the interpretation of the current–voltage characteristic of the collector. An analysis is advanced which allows for the distribution of kinetic energy about the average for the ions. On this basis the electron temperatures and negative vehicle potential would be much less than the figures of 15 000°K and 6.4 volts previously published.

W.T.Blackband

551.5 : 525

8374 SOLAR AND DIURNAL EFFECTS IN THE UPPER ATMOSPHERE [DEDUCED] FROM OBSERVATIONS OF ARTIFICIAL EARTH SATELLITES.

W.Priester and H.A.Martin.

ForschBer. Landes Nordrhein-Westfalen, No. 547, 53 pp. (1960). In German.

Measurements of upper-atmosphere density derived from the observed orbital motions of earth-satellites 1958 α, β_2, and δ, are used in conjunction with observational data on 20 cm solar radio-emission to establish the following facts: (1) a significant correlation exists, at least over the 21 month period, Nov. 1957 - Jul. 1959, between variations of solar activity (20 cm radiation) and upper-atmosphere density at altitudes of 208-210, 260, 350, and 660 km; (2) a diurnal fluctuation of air density with maximum value at zero geocentric angle (angle subtended at earth's surface between satellite at perigee, and sun) is found for all altitudes, the amplitude of fluctuation increasing with height; (3) daily variations of temperature occur at heights between 200 and 700 km. For example, at 660 km over the equatorial zone the observed range of temperature is from 1.8×10^3 °K (at 13^h U:T:) to 1.2×10^3 °K (at 1^h U.T.). Results are tabulated for a model atmosphere, based on selected values of the two variables, geocentric angle, χ, and the observed intensity, S, of solar 20 cm radiation (unit, 10^{-22} W/m^2. c/s).

D.R.Barber

551.5 : 525

SATELLITE DOPPLER MEASUREMENTS AND THE IONOSPHERE.

See Abstr. 6633

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8375

ON LOWER IONOSPHERE ELECTRON DETACHMENT- AND RECOMBINATION COEFFICIENTS OBTAINED FROM MEASUREMENTS OF NONDEVIATIVE IONOSPHERIC ABSORPTION.

B.Hultqvist.

Ark. Geofys., Vol. 3, Paper 6, 97-110 (1959).

From measurements of total ionospheric nondeviative absorption with the aid of a self-balancing cosmic noise receiver (the Riometer) average values for the lowest ionosphere of the ratio between photo detachment and collisional detachment coefficients and also of the ion-ion recombination coefficient have been estimated.

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8376

TIME AND HEIGHT VARIATIONS IN THE DAYTIME PROCESSES IN THE IONOSPHERE.

A.P.Mitra.

J. geophys. Res., Vol. 64, No. 7, 733-43 (July, 1959).

An extension of earlier work by Mitra and Jones (Abstr. 1386 of 1955). The height variations of the various dissipative processes occurring in the ionosphere over a height range of 50 to 600 km are described and an expression is given for the calculation of the loss coefficient over the entire ionosphere. For noon conditions, defined by the hours 1030 to 1330 L.M.S.T., and for stations in the northern middle latitude zone, the equation for the loss coefficients for heights in the range of 50 to 600 km is

$$\alpha = 5 \times 10^{-21} n(O_2) + 3 \times 10^{-20} n(O) + \frac{2 \times 10^{-19} n(O_2)}{2 \times 10^{-11} n(O_2) + 1 \times 10^{-8} N_e} + 1 \times 10^{-12} \text{ cm}^3/\text{sec.}$$

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8377

ON THE IMPORTANCE OF THE RESONANCE-LINES OF ATOMIC OXYGEN TO THE IONOSPHERIC IONIZATION.

Y.Inoue.

J. atmos. terrest. Phys., Vol. 15, No. 1-2, 85-8 (Sept., 1959).

A new interpretation of the effective recombination-coefficients of an electron in the ionosphere is advocated. A new theory for the ionization mechanism in the ionosphere is also brought forward. The resonance lines of atomic oxygen are of 1302-1306 A, 3s $^3S^0$-$2p^3P$, and 1025.7 A, $3d^3D^0$-$2p^3P$. These lines were observed at 115 km as a strong emission. The new theories of the ionosphere are discussed, relating to the interpretation of the formation of these emission-lines in the ionosphere.

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8378

WIND SYSTEMS AND DRIFT MOTIONS IN THE IONOSPHERE DEDUCED FROM THE DYNAMO THEORY.

M.Hirono, H.Maeda and S.Kato.

J. atmos. terrest. Phys., Vol. 15, No. 1-2, 146-50 (Sept., 1959).

Since the analyses and theoretical researches of Martyn (1947) and others it is increasingly evident that the ionization drift due to electrodynamic forces may produce a number of anomalies in the ionosphere. In recent years the equatorial anomaly of the F2-region was studied (Maeda, 1953; Hirono and Maeda, 1954) and it was shown that the main part of the anomaly can be interpreted by vertical ionization drift accompanied by solar magnetic variation. These results suggest that many other ionospheric anomalies may be interpreted by drift due to the current system producing the daily magnetic variation. The dynamo theory of the ionosphere has been investigated by many workers, but most problems were unsolved as regards daily variation of the anisotropic electrical conductivity. An attempt to solve these problems is presented.

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8379

NOCTURNAL IONIZATION OF THE E-REGION AND GEOMAGNETIC ACTIVITY.

A.Haubert.

J. atmos. terrest. Phys., Vol. 15, No. 1-2, 84 (Sept., 1959). In French.

A good correlation has been found at Casablanca between the appearance on the ionograms of a thick nocturnal layer underneath the F-region, and the increase of magnetic activity. Similar evidence was obtained at Fribourg in 1957. This phenomenon merits study on a world-wide scale.

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8380

REGION-E AND SOLAR ACTIVITY.

W.J.G.Beynon and G.M.Brown.

J. atmos. terrest. Phys., Vol. 15, No. 1-2, 168-74 (Sept., 1959).

Since the various ionospheric layers arise, directly or indirectly, from solar radiation of more than one wavelength, and these radiations may well vary unequally, it is to be anticipated that an ionospheric index of solar activity based on one layer only will not adequately represent solar activity changes. Some aspects of region-E and solar activity are discussed.

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8381

STUDY OF THE TRANSPARENCY OF THE IONOSPHERIC LAYER CALLED SPORADIC-E.

K.Rawer.

C.R. Acad. Sci. (Paris), Vol. 250, No. 8, 1517-19 (Feb. 22, 1960). In French.

An index called the "degree of occultation" of sporadic-E clouds is defined. Records have been examined from many observatories throughout the world. In temperate latitudes, the degree of occultation is high by day but low at night. For stations in a zone centred on the geomagnetic equator, the layer is found to be very transparent but more so at night than during the day. In the auroral zone, Es is rarely observed by day but at night, the median value of the degree of occultation is greater than that at temperate latitudes.

H.J.A.Chivers

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8382

EFFECT OF THE S_q CURRENT SYSTEM ON THE IONOSPHERIC E- AND F1-LAYERS.

T.Shimazaki.

J. atmos. terrest. Phys., Vol. 15, No. 1-2, 77-82 (Sept., 1959).

The discrepancy between the observed f_0E or f_0F1 and those predicted by the Chapman theory was examined in detail. The result shows that the F1-layer varies in a more regular manner than the E-layer, and that the discrepancy in the E-layer may be attributed partly to the effect of scale height gradient, but the principal cause certainly lies in the effect of S_q overhead current system. Discussion is made on the non-uniform motion of vertical drift velocity produced by this effect, as well as on the recombination coefficient and the scale height gradient in these regions.

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8383

THE TEMPERATURE GRADIENTS IN THE E- AND F1-REGIONS FROM THE IONOSPHERIC SOUNDINGS MADE AT CASABLANCA.

A.Haubert.

J. atmos. terrest. Phys., Vol. 15, No. 1-2, 83 (Sept., 1959). In French.

The interpretation of the measurements made at Casablanca on the E- and F1-regions, using Chapman's theory, indicates that the temperature gradient is normally positive in the E-region and normally slightly negative in the F1-region, with a seasonal variation so marked as to provoke inversion.

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8384

MOVEMENTS IN THE QUIET F-LAYER OVER SLOUGH.

J.A.Ratcliffe, A.R.Robbins and J.O.Thomas.

J. atmos. terrest. Phys., Vol. 15, No. 1-2, 21-6 (Sept., 1959).

Electron density profiles have been deduced from h'(f) curves recorded at Slough once per hour on every day of each of six representative months. Allowance was made for the effects of the earth's magnetic field and the ionization below the F-layer. The average behaviour on magnetically quiet days is described and discussed, with particular reference to the possible magnitude and phase of vertical movements in the F-region.

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8385

THE DISTURBED F-LAYER OVER SLOUGH.

A.R.Robbins and J.O.Thomas.

J. atmos. terrest. Phys., Vol. 15, No. 1-2, 102-7 (Sept., 1959).

Electron density profiles for magnetically disturbed days have been compared with those for quiet days. The effect of disturbance on the height of the peak of the F2-layer (h_mF2), on the maximum electron density (N_m) and the total electron content below the F2-layer peak (n_T), is discussed. It is emphasized that the quantity h'F2 frequently used in the past in describing the effect of disturbance is without physical significance, and can be seriously misleading. Evidence is presented to show that appreciable changes sometimes occur in the ionosphere near the time of a magnetic sudden impulse.

551.5

8386 EQUATORIAL SPREAD-F.

R.W.Wright and N.J.Skinner.

J. atmos. terrest. Phys., Vol. 15, No. 1-2, 121-5 (Sept., 1959).

Spread-F conditions have been examined for six low-latitude stations — Dakar, Khartoum, Djibouti, Ibadan, Nairobi and Leopoldville. It is shown that, contrary to the general view, occurrence of disturbed magnetic conditions inhibits the occurrence of spread-F layers during the southern solstice at all these stations. The seasonal variation of the occurrence of spread-F is considerably changed if, instead of all days, only magnetically quiet days are considered. In the northern winter there appears to be widespread correlation of occurrence of spread-F across Africa. This is shown to be due to the magnetic influence.

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8387 ON THE LARGE VERTICAL MOVEMENTS OF THE F-REGION OBSERVED AT CASABLANCA.

A.Haubert.

J. atmos. terrest. Phys., Vol. 15, No. 1-2, 145 (Sept., 1959).
In French.

Rapid vertical movements of the F-region have been observed at Casablanca, with an occurrence frequency reaching 10 days/month, around 21 hr and 5 hr. These movements, apparently unconnected with geophysical or solar perturbations, appear to be capable of interpretation as tidal phenomena.

551.5

8388 ON THE OCCURRENCE OF THE F1½-LAYER AT TOKYO.

I.Kasuya.

J. atmos. terrest. Phys., Vol. 15, No. 1-2, 126-9 (Sept., 1959).

From a statistical analysis on a basis of routine ionospheric observations at Tokyo (Kokubunji) throughout the last solar cycle, it is found that annual, seasonal and diurnal variations exist in the frequency of occurrence of the intermediate layer, the F1½-layer at the middle latitude of Tokyo. The F1½-layer appears mostly in the daytime and is prevalent at both equinoxes, especially remarkable in late spring during years of high solar activity — there has been good correlation between the frequency of occurrence and the number of sunspots.

551.5

8389 A STUDY OF THE MORPHOLOGY OF IONOSPHERIC STORMS.

S.Matsushita.

J. geophys. Res., Vol. 64, No. 3, 305-21 (March, 1959).

A study was made of the variations of the maximum electron number density in the ionospheric F2 layer during magnetic storms. Fifty-one strong storms and 58 weak storms were studied. The data were collected during the ten-year period 1946-1955, at 38 ionospheric stations between 60.4° geomagnetic latitudes. The ionospheric stations were put into eight zones according to their geomagnetic latitudes. Storm-time variations in the maximum electron number density (Dst) and disturbance daily variations during each six-hour period (DS) were obtained for each of the eight zones. The Dst variation in higher middle-latitudes was characterized by an initial short increase followed by a much larger decrease, the amplitude of the decrease being accentuated in summer. In the equatorial region, however, the phase of the variation was the opposite of that in higher latitudes. There was generally an increase after an initial short decrease, with no seasonal effect. The Dst variation at intermediate latitudes resembled that at higher latitudes in summer and that at the equatorial region in winter, with the average over all seasons being relatively flat. The diurnal component of the DS variation for each six-hour period indicated, on the harmonic dial, a change in the clockwise sense except in the equatorial region. The maximum amplitude of the diurnal component of the mean of the DS variations showed a gradual decrease from higher toward lower latitudes, with a subsequent increase in the equatorial region. A remarkable change of the phase of the diurnal component also occurred from higher toward lower latitudes.

551.5

8390 THE DIURNAL DEVELOPMENT OF THE ANOMALOUS EQUATORIAL BELT IN THE F2 REGION OF THE IONOSPHERE.

R.G.Rastogi.

J. geophys. Res., Vol. 64, No. 7, 727-32 (July, 1959).

The latitudinal variation in the critical frequency of the F2 layer was studied for each hour of the day during the equinoctial months of a year at sunspot minimum. The middle latitude maxima first develop at low latitudes and shift poleward with the progress of the day, the course being reversed in the evening hours. The double maxima in the diurnal variation of foF2 are less separated with increasing latitude and finally converge to a single maximum at a dip of about 25°. These two anomalies in foF2 are suggested as being due to the vertical drift of ionization, together with its motio towards the poles in the morning and towards the equator in the afternoon. Other anomalies of F2 can also be explained by a meridional transport of ionization.

551.5

8391 A NEW THEORY OF FORMATION OF THE F2-LAYER

T.Yonezawa.

J. atmos. terrest. Phys., Vol. 15, No. 1-2, 89-94 (Sept., 1959).

The importance is emphasized of the role played by electron-io diffusion in the mechanism of formation of the F2-layer. Taking in account the electron-ion diffusion in the gravitational field as well as the electron-ion movement in the vertical direction, the velocity of which is assumed to increase exponentially with height, height distri tions of electron density for steady-state conditions have been calculated and discussed. The latitudinal distributions of the maximum electron density and the height of its level have also been obtained and compared with observations, resulting in a reasonable agreement at least in their broad features.

551.5

8392 IONOSPHERIC F2-DISTURBANCES ASSOCIATED WITH GEOMAGNETIC STORMS.

T.Sato.

J. atmos. terrest. Phys., Vol. 15, No. 1-2, 116-20 (Sept., 1959).

An attempt is made to explain the ionospheric F2-disturbances associated with the geomagnetic storms by the electron drift theory A study is made of the individual states of the disturbances. The results show that the F2-disturbances in the equatorial zone and mo of disturbances in middle latitudes can be explained as the effects of the vertical drift of electrons.

551.5

8393 DYNAMICAL STRUCTURE OF THE IONOSPHERIC F2-LAYER AS DEDUCED FROM THE WORLD-WIDE DAILY VARIATIONS.

T.Shimazaki.

J. atmos. terrest. Phys., Vol. 15, No. 1-2, 108-15 (Sept., 1959).

Recourse was made to numerical calculations to find the effects of various non-uniform vertical motions due to diffusion, thermal and/or tidal variations on daily variations in the F2-layer. A metho of solving the problem was worked out so that the electron density distribution may return back every 24 hr regardless of non-recurren motions of each part produced by several causes. The comparison of calculated and observed variations shows that the Bradbury model is better than the Chapman model in every respect. Special emphasis is placed upon the fact that the effect of non-uniform semi-diurnal vertical drift velocities with height gradient of both amplitude and phase is very important except near the equator.

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8394 LATITUDE DEPENDENCE OF f_0F2 OVER THE RANGE OF 20°N TO 69°S, OBTAINED BY SHIP-BORNE IONOSPHERIC SOUNDER.

M.Ōse, K.Aida and H.Okamoto.

J. atmos. terrest. Phys., Vol. 15, No. 1-2, 130-1 (Sept., 1959).

551.5 : 525

8395 SOME DEDUCTIONS OF IONOSPHERIC INFORMATION FROM THE OBSERVATIONS OF EMISSIONS FROM SATELLITE 1957α2. I. THE THEORY OF THE ANALYSIS.

G.J.Aitchison and K.Weekes.

J. atmos. terrest. Phys., Vol. 14, No. 3-4, 236-43 (June, 1959).

The launching of the first artificial earth satellite (1957α) by the USSR provided an opportunity of obtaining information about the ionosphere at heights above the F2-peak. The satellite emitted radio waves of frequency 20 and 40 Mc/s which were appreciably modified during their transmission through the ionosphere to the ground. It is possible to obtain information about the distribution of ionization by making suitable observations on the received wave. The most useful quantities for this purpose are the Doppler frequency shift and the fading of the signal caused by the magneto-optical Faraday effect An approximate theory of these two phenomena is developed, and use to interpret some observations.

551.5 : 525

8396 SOME DEDUCTIONS OF IONOSPHERIC INFORMATION FROM THE OBSERVATIONS OF EMISSIONS FROM SATELLITE 1957α2. II. EXPERIMENTAL PROCEDURE AND RESULTS.

G.J.Aitchison, J.H Thomson and K.Weekes.

J. atmos. terrest. Phys., Vol. 14, No. 3-4, 244-8 (June, 1959).

For the application of the approximate analysis described in Part I (see preceding abstract), it was necessary for the satellite track to pass sufficiently near the receiving site for the angle of incidence to be less than about 45° for a period of about 30 sec. The tracks which satisfied these conditions fell naturally into two groups. In one the height was 200-220 km, well below h_mF2, and since it occurred at night the ionization in E-region was very small, and in the other the height was about 500 km, well above h_mF2, and the time of observation was in the early morning. The high transits for which the satellite passed most nearly overhead were 0531 hours 11 October, 0531 hours 12 October, 0339 hours 18 October and 0335 hours 19 October. The assumption of horizontal stratification of the ionosphere is doubtful for the 0530 group as this is rather near sunrise and consequently the analysis was limited to the 0330 group of transits for 17-22 October. The number of results available was so small that some records were analysed for intervals for which the angle of incidence appreciably exceeded 45°.

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8397

THE OUTERMOST IONOSPHERE.

S.Chapman.

J. atmos. terrest. Phys., Vol. 15, No. 1-2, 43-7 (Sept., 1959).

Speculations made by the writer regarding the extension of the solar corona up to and beyond the earth's orbit are considered in connection with the constitution of the outer ionosphere, above the F2-peak. If the sun's magnetic field is radially limited so as not to affect the outward flow of heat from the corona, the earth must be immersed in a very hot (200 000°) interplanetary atmosphere mainly consisting of ionized atomic hydrogen — the protons and electrons numbering about a thousand per cubic centimetre. Heat must flow from this gas into the earth's atmosphere. Above the F2-peak the atmosphere will first consist increasingly of ionized atomic oxygen, under-lying an extensive layer of nearly neutral atomic hydrogen. The temperature continually increases upwards and at high levels the atomic hydrogen gradually merges with the interplanetary gas. Above the neutral hydrogen layer, the heat inflow is greatest in polar latitudes.

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8398

RADIATION OBSERVATIONS WITH SATELLITE 1958 ϵ.

J.A.Van Allen, C.E.McIlwain and H.Ludwig.

J. geophys. Res., Vol. 64, No. 3, 271-86 (March, 1959).

A preliminary account is given of the radiation observations made with Satellite 1958 ϵ. The earlier discovery of the great radiation belt around the earth with Satellites 1958 α and 1958 γ has been confirmed and greatly extended with an apparatus of much greater dynamic range and discrimination. It appears likely that many important geophysical phenomena are intimately related to the reservoir of charged particles found to be trapped in the outer reaches of the earth's magnetic field.

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8399

GAMMA-RAY BURST FROM A SOLAR FLARE.

L.E.Peterson and J.R.Winckler.

J. geophys. Res., Vol. 64, No. 7, 697-707 (July, 1959).

A burst of high-energy radiation coincident with a solar flare has been detected during a balloon flight at 10 g/cm² atmosphere depth and 30° geomagnetic latitude over Cuba. The flare occurred at 1305 U.T. on March 20, 1958 and was associated with solar radio bursts on 1500 and 10 000 Mc/s. Terrestrial effects included a SID, earth-current disturbances, and a magnetic crotchet. The 18 sec burst was detected with an integrating ionization chamber and a single Geiger counter. From these two instruments and their ratio, it is inferred that the radiation is due to a γ-ray flux of about 2×10^{-5} ergs/sec cm² peaked in the 200 - 500 keV region. This radiation can be interpreted as bremsstrahlung produced in the solar photosphere from electrons of 0.5 to 1 MeV energy. These same electrons, spiraling in a 1000 G field in the flare region, can produce the observed radio burst by betatron radiation. The high-energy electrons represent about 1% of the flare energy. Only about 0.01% of the emitted betatron radiation escaped from the flare region toward the earth.

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8400

SOME PROPERTIES OF THE VAN ALLEN RADIATION.

A.J.Dessler and R.Karplus.

Phys. Rev. Letters, Vol. 4, No. 6, 271-4 (March 15, 1960).

It is pointed out that the results of the observations of the outer zone of the Van Allen radiation belt made with the Explorer IV and Explorer VI satellite systems are inconsistent with the solar injection hypothesis. On the other hand, the electrons released in the decay of cosmic-ray neutron albedo may represent a satisfactory source for the outer electron belt. The magnetic-storm-induced fluctuations in the radiation belt are also discussed.

S.J.St.-Lorant

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8401

VISUAL OBSERVATION OF THE AURORA.

C.W.Gartlein.

Ann. Geophys., Vol. 15, No. 1, 31-8 (1959).

The various methods used since the middle of last century for the statistical tabulation and analysis of visual auroral observations are discussed in detail with especial reference to the United States—Canadian programme (1938), and the more refined methods used in recent combined researches (since 1955) culminating in the I.G.Y. "All-sky" project. Finally, the main results obtained from the long-term study of auroral forms and distribution are discussed in relation to those found recently by Kyhl and Webster (1957) from a laboratory study of unstable, hollow electron beams in h.f. radio transmitting valves. What appear to be significant similarities are found between the two phenomena.

D.R.Barber

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8402

AURORAL X-RAYS, COSMIC RAYS, AND RELATED PHENOMENA DURING THE STORM OF FEBRUARY 10-11, 1958.

J.R.Winckler, L.Peterson, R.Hoffman and R.Arnoldy.

J. geophys. Res., Vol. 64, No. 6, 597-610 (June, 1959).

Balloon observations were made during the auroral storm of February 10-11, 1958, at Minneapolis. Strong X-ray bursts in two groups were detected. The groups appeared coincident with two large magnetic bays, with strong radio noise absorption, and with the passage across the zenith of a very large amount of auroral luminosity. From the X-ray intensity and measured energies, an electron current of 0.6×10^{8} electrons/cm²/sec was present. These electrons ionizing the upper D layer accounted for the increased cosmic noise absorption. The X-rays themselves carried 1000 times less energy than the electrons and could not provide sufficient ionization for the observed radio absorption. Visual auroral forms during this storm are reported to have lower borders at the 200 to 300 km level. There is thus a difficulty in bringing the electrons to the D layer without an accompanying visible aurora. A cosmic-ray decrease accompanied the storm and was observed to be from 4 to 6% at sea level, 21% in the balloon altitude ionization, and 15% in total energy influx at 55° geomagnetic latitude. Compared with the great intensity of the magnetic and auroral phenomena in this storm, the cosmic-ray modulation was not exceptionally large.

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8403

AURORAS, MAGNETIC BAYS, AND PROTONS.

R.C.Bless, C.W.Gartlein, D.S.Kimball and G.Sprague.

J. geophys. Res., Vol. 64, No. 8, 949-53 (Aug., 1959).

Various statistical and detailed studies of the relation between auroras and bays are presented. It appears that bays and auroras are manifestations of the same phenomenon. Numerical estimates are presented which indicate that the bay can be caused by atmospheric winds operating on ionized particles produced by incoming 50 keV solar protons. It is not necessary to postulate any dynamo action.

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8404

A THEORY OF SPREAD F BASED ON A SCATTERING-SCREEN MODEL.

J.Renau.

J. geophys. Res., Vol. 64, No. 8, 971-7 (Aug., 1959).

A thin scattering screen is postulated above the E region. The virtual height which is associated with a pulse radiated from the sounder, forward scattered by the screen and then reflected back to the sounder via the F region, is calculated. For frequencies appreciably larger than the penetration frequency, the minimum virtual height v. the operating frequency, on a linear scale, is a straight line, the slope of which depends on the height of the screen. As the height of the screen increases, the slope decreases. When the scattering screen is assumed at the level of reflection, the slope of the line coincides with the tangent from the origin to the regular vertical-incidence trace. Experimental ionograms are presented that fit the suggested mechanism.

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8405 DISTURBANCES IN THE LOWER AURORAL IONOSPHERE. S.Chapman.

J. atmos. terrest. Phys., Vol. 15, No. 1-2, 29-37 (Sept., 1959).

The solar particles that enter the atmosphere and produce the luminous aurora are known to include protons, which also ionize the atmosphere. As suggested by Bates, their ionizing action may extend below the level of their own penetration, by the Lyman α photons they emit. These can penetrate to about 75 km, and ionize nitric oxide. Recent rocket researches by Van Allen and his colleagues prove that the primary auroral particles also include electrons, with energies up to 100 keV. These penetrate to about 80 km, thus directly extending the auroral ionization well below the level of auroral luminosity. Indirectly these electrons ionize the atmosphere down to far lower levels, by the X-rays emitted by a small fraction of the electrons. Winckler's balloon results show that such ionization extends at least down to 32 km. This ionization below the level of the visible aurora accounts for most of the absorption, in auroral regions, of high frequency radio waves. Though the primary electron flux at night probably exceeds that by day, the secondary electrons are often more numerous (and absorbent) by day than by night. This is because, by day, photodetachment prolongs the free life of these electrons, despite their ready attachment to oxygen.

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8406 INTERFEROMETRIC MEASUREMENT OF THE WIDTHS OF THE 6300 A [O I] AND 5198-5200 A [N I]. EMISSIONS IN THE AURORAE POLARIS. T.M.Mulyarchik.

Dokl. Akad. Nauk SSSR, Vol. 130, No. 2, 303-6 (Jan. 11, 1960). In Russian.

551.5

8407 AURORAL FREQUENCY LINES. J.M.Stagg; B.Hultqvist.

Nature (London), Vol. 184, 262, 262-3 (July 25, 1959).

Stagg comments on Hultqvist's recent comparison (Abstr. 793 of 1960) of Gartlein's I.G.Y. auroral data and the lines of auroral frequency drawn by Vestine (1944) with frequency lines deduced theoretically. He criticizes the deductions from this comparison on the grounds that (1) since the belt of maximum auroral frequency moves southward at times of most intense activity, strictly similar methods should be used to reduce the different sets of data derived at dissimilar epochs; (2) since auroral observations are made only under clear skies during the hours of darkness, corrections to the statistical data are required to compensate for the incidence of cloud and daylight.

In reply Hultqvist, after considering the various points raised by Stagg, re-affirms his conclusion that Gartlein's data fit the theoretical frequency distribution better than do the earlier Vestine results based partly on the original data of Fritz (1873).

D.R.Barber

551.5 : 539.18

LIFE-TIME OF THE ATOMIC OXYGEN 6300 A LINE IN THE AURORAL SPECTRUM. See Abstr. 7728

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8408 OBSERVED CHARACTERISTICS OF AN ULTRA-HIGH-FREQUENCY SIGNAL TRAVERSING AN AURORAL DISTURBANCE.

J.C.James, L.E.Bird, R.P.Ingalls, M.L.Stone, J.W.B.Day, G.E.K.Lockwood and R.I.Presnell.

Nature (London), Vol. 185, 510-12 (Feb. 20, 1960).

Continuous-wave signals on 440 Mc/s have been directed at the moon from a high-latitude station, and the reflected waves have been observed at two mid-latitude stations. The polarization and fading rate of the echo has been studied and these vary in a regular way on most days. On occasions when an auroral display was in the path of the signal, however, rapid fluctuations in the polarization angle were observed together with an increase in the fading rate. There was no measurable absorption of the signal. The changes in polarization angle are probably due to changes in the electron content in the ionosphere, of the order of 10^{17} electrons in a vertical column of 1 sq. m cross-section.

H.J.A.Chivers

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8409 SOME RADIO REFLECTION AND TRANSMISSION PROPERTIES OF THE AURORA. R.B.Dyce.

Publ. Astron. Soc. Pacific, Vol. 71, 510-16 (Dec., 1959).

A short account of auroral investigations using a high-powered radar equipment. Direct reflections from aurora were observed. In addition the transmission properties have been studied by investigating the variations in echo strength from a signal reflected from artificial satellite at the time of an aurora. Similar studies have been carried out using the moon as a reflector. The observations indicate that the aurora consists of a region of weak scatterers which absorb only a small fraction of energy in the forward directio Because overdense ionization is not necessarily present the electro density cannot be determined by radio reflections from auroral ionization.

C.Hazar

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8410 PHOTOELECTRIC MEASUREMENTS OF HYDROGEN EMISSIONS IN AURORAE AND AIRGLOW. R.Montalbet

J. atmos. terrest. Phys., Vol. 14, No. 3-4, 200-12 (June, 1959).

Observations are reported on hydrogen emissions in aurorae and airglow made with a scanning spectrometer during the period 10-24 February 1958 at Churchill, Manitoba. No systematic relatio ship between the occurrence of the Hβ line and the usual auroral forms was noted, with the exception of very strong active displays i which hydrogen emissions were not observed. Measurements of the intensity and profile of the Hβ line indicate that a proton flux of som 10^7-10^8 protons/cm² sec, with some protons having an initial velocit of ≥3000 km/sec, are associated with some auroral displays. Strong hydrogen emissions, along with enhanced airglow radiations, were detected during an interval of no visible aurorae. Assuming that light scattering played an important role in the measurements, the Hα and Hβ line profiles can be explained by an influx of monoenergetic protons having an initial velocity of about 1200 km/sec. The flux for the beginning of the enhanced radiations was calculated to be of the order of 10^8 protons/cm² sec.

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8411 THE NIGHT-SKY SPECTRUM λλ 5000-6500 A. D.E.Blackwell, M.F.Ingham, and H.N.Rundle.

Astrophys. J., Vol. 131, No. 1, 15-24 (Jan., 1960).

A spectrum of the night sky obtained at the cosmic-ray station of Chacaltaya (latitude -16°, height 17 100 ft) at zenith distance 84°, using a dispersion of 78 A/mm is described. The spectrum is unusually intense, and in the region λλ5577-6500 fifty-one OH emission lines (some of which are multiple) are identified; the spin doubling of many lines is clearly resolved. A comparison between observed frequencies and frequencies calculated by means of newly derived band origins and rotational constants is given. Rotational temperatures are determined, and the absolute intensities of OH lines and the N I emission at λ 5199 have been measured. The fine structure of the OH emission in the region of Hα is calculated.

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8412 DOPPLER WIDTHS OF THE ATOMIC OXYGEN LINES IN THE AIRGLOW. D.Q.Wark.

Astrophys. J., Vol. 131, No. 2, 491-501 (March, 1960).

The widths of the forbidden atomic oxygen lines in the airglow have been measured, using a Fabry—Perot interferometer, and temperatures of the emitting layers have been inferred. The lines λ 5577 in the night sky and λ 6300 in the twilight, the aurora, and the night sky yielded temperatures of 184°, 710°, 730°, and 980°K, respectively, with mean-square errors of about 10%. Corresponding tentative heights of the emitting layers have been suggested as 100, 205, 210, and 270 km.

551.5

8413 THE TELLURIC HYDROGEN CORONA. F.S.Johnson and R.A.Fish.

Astrophys. J., Vol. 131, No. 2, 502-15 (March, 1960).

The source of the Lyman-α radiation incident upon the ionospheric E region at night is here identified as scattering of solar Lyman-α radiation by hydrogen atoms in a corona surrounding the earth and constituting the outer fringe of the neutral component of the earth's atmosphere. Doppler shifts, which would be expected if the Lyman-α radiation originated in a cloud of hydrogen atoms in interplanetary space, provide a compelling reason for believing that the radiation must originate in a cloud which is an extension of the earth's atmosphere. The details of the observed night-time Lyman-α intensity distribution make it possible to determine the optical thickness of the hydrogen corona around the earth. Knowledge of the temperature of the earth's exosphere is required to calculate the vertical distribution of hydrogen, and this temperature is obtained primarily from the observed rate of orbital decay of the Vanguard I satellite, 1958β2. The hydrogen concentration is found to fall from

4×10^4 atoms cm^{-3} at an altitude of 550 km to 10^3 atoms cm^{-3} at 7000 km and 10 atoms cm^{-3} at 36 000 km. The optical thickness of the hydrogen above 1200 km is slightly over unity.

551.5

8414 ON THE EXCITATION RATES AND INTENSITIES OF OH IN THE AIRGLOW. J.W.Chamberlain and C.A.Smith.

J. geophys. Res., Vol. 64, No. 6, 611-14 (June, 1959).

Published photometric observations of several OH bands are analysed with the aid of available transition probabilities. The rate of excitation of the vibrational levels with $v \leq 9$ by the excitation mechanism seems to be nearly independent of v. The relative populations of the vibrational levels are computed, and the predicted absolute intensities of all the OH bands are given.

551.5

8415 REPORT ON SPECTROGRAPHIC WORK AT TROMSÖ AND OSLO. L.Vegard.

J. atmos. terrest. Phys., Vol. 15, No. 1-2, 175 (Sept., 1959).

This report deals with some results of spectrographic work carried out at Tromsö and Oslo in order to study the properties of the solar bundles formed by photoelectrons from sunspot regions and neutralized by protons.

551.5

8416 PORTABLE AIRGLOW PHOTOMETER. B.J.O'Brien and G.de La Harpe.

J. sci. Instrum., Vol. 37, No. 2, 54-6 (Feb., 1960).

A simple, direct-reading and sensitive photometer which is easily transported and is independent of external power supplies is described. Details of the optical system and the electronic circuitry are given, and the performance of the apparatus is discussed.

551.5

8417 INTERPLANETARY MATTER AND THE INCREASED NIGHTGLOW. C.Hoffmeister.

Z. Astrophys., Vol. 49, No. 4, 233-42 (1960). In German.

Thirty years' statistics of the increased airglow show that its maxima exhibit a strong tendency to recur annually throughout the whole period of observation. A relation to meteoric currents is indicated with a high degree of probability. The interaction of gravitation and radiation pressure leads to a preference of short period currents, especially those with semi-major axes < 5 astronomical units. There is some indication of a relation to solar activity, the airglow maxima coinciding with sunspot minima. This phenomenon, as well as a very distinct decrease of airglow activity after 1947, can also be explained by changes of radiation pressure.

551.5

8418 THE INFRARED RADIATION FLUX IN THE ATMOSPHERE. G.N.Plass.

Proc. Inst. Radio Engrs., Vol. 47, No. 9, 1448-51 (Sept., 1959).

A review article, describing the factors which influence energy transfer through the atmosphere, and the heat balance of the earth. C.Hilsum

551.5

8419 A SIMPLE PRISM SPECTROGRAPH FOR ABSOLUTE MEASUREMENT OF INFRARED ATMOSPHERIC RADIATION (4 TO 15 μ). H.J.Bolle.

Z. angew. Phys., Vol. 12, No. 3, 125-33 (March, 1960). In German.

The spectrometer uses a NaCl prism and a Golay detector; high signal/noise ratio is obtained by using a long time constant. Measurements are made absolute by calibration with a black-body cavity. Wavelength–intensity curves are shown for various zenith angles, times of year and cloud formations. Near 6-7 and 14 μ, the intensities approach very close to those of a black radiator at the ground temperature. G.F.Lothian

551.5

8420 MEASUREMENT OF VISUAL RANGE. P.Crosby.

Nature (London), Vol. 185, 438-9 (Feb. 13, 1960).

Two photoelectric instruments are described, one a version of Waldram's polar nephelometer and the other a version of Beuttell and Brewer's integrating nephelometer. They are used to measure the scattering coefficent, b, of the atomsphere. Results are quoted as 'visual range', V where $V=3.912/b$. The special features are given and they are of particular value to meteorologists because a direct reading is given and visual fatigue is eliminated. R.S.Read

551.5

8421 THE TRANSMISSION OF THE ATMOSPHERE IN THE INFRARED. J.N.Howard.

Proc. Inst. Radio Engrs, Vol. 47, No. 9, 1451-7 (Sept., 1959).

A review of present knowledge of atmospheric transmission at wavelengths between 1 and 24 microns. C.Hilsum

551.5 : 534.26

SOUND SCATTERING IN A TURBULENT ATMOSPHERE. See Abstr. 6878

551.5 : 537.52

8422 A THEORY OF BALL LIGHTNING FORMATION. W.K.R.Watson.

Nature (London), Vol. 185, 449-50 (Feb. 13, 1960).

Following a recent suggestion by Kapitza it is shown that a polarized electromagnetic standing wave can produce containment of charged particles near its electric nodes and this phenomenon may assist in the initial stages of fireball formation. R.H.Golde

551.5 : 621.316.98

8423 WAVEFORM STUDIES OF ELECTRIC FIELD-CHANGES DURING CLOUD-TO-CLOUD LIGHTNING DISCHARGES. B.A.P.Tantry, R.S.Srivastava and S.R.Khastgir.

Proc. Nat. Inst. Sci. India A, Vol. 23, No. 6, 499-503 (1957).

The sign of the electric field-changes during the lightning discharge and the relatively small time-interval (0.5 to 2.5 msec) between successive discharges in multiple strokes enable identification of oscillograms showing waveforms originating from cloud-to-cloud discharges. A large number of oscillographic records taken at Banaras during 1952-1955 with the help of an automatic atmospherics recorder revealed that waveforms due to cloud-to-cloud discharges have features similar to those due to cloud-to-ground discharges in respect of (i) multiple strokes; (ii) "predischarges"; (iii) return-stroke pulses with or without ionospheric reflections; (iv) c-field changes and "hook" components and (v) junction field-changes. The relevant experimental results are discussed and typical oscillograms showing waveforms due to cloud-to-cloud discharges are shown.

551.5 : 537.56

CHARGE EQUILIBRIUM IN AEROSOLS ACCORDING TO THE BOLTZMANN LAW. See Abstr. 7073

551.5

8424 INVESTIGATION OF THE EQUATORIAL ELECTROJET BY ROCKET MAGNETOMETER. L.J.Cahill, Jr.

J. geophys. Res., Vol. 64, No. 5, 489-503 (May, 1959).

A small rocket magnetometer has been developed for use in investigation of electrical currents in the ionosphere. In three flights near the magnetic equator electrical currents were detected. The equatorial electrojet was found to consist of at least two layers of electrical current, one layer near an altitude of 100 km and the other 20 to 25 km higher. A current flowing in the opposite direction to the main electrojet current was found to the north of the electrojet.

551.5

8425 CONSTANT IONOSPHERE HEIGHT FOR AUDIO-FREQUENCY PROPAGATION. F.Hepburn.

Nature (London), Vol. 85, 599 (Feb. 27, 1960).

Calculation of the height of reflection of audio-frequency atmospherics originating from distant lightning flashes, gave a figure of 83 ± 2 km irrespective of the time of day. A slight diurnal variation of attenuation at frequencies in the range 4-14 kc/s has been noted, and source spectra have been constructed over this frequency range. H.J.A.Chivers

551.5 : 621.391.821

8426 MEASURED FREQUENCY SPECTRA OF VERY-LOW-FREQUENCY ATMOSPHERICS. T.Obayashi.

J. Res. Nat. Bur. Stand., Vol. 64D, No. 1, 41-8 (Jan.-Feb., 1960).

New spectroscopes recording continuously the amplitude-frequency spectra of v.l.f. atmospherics have been developed. Two receivers cover the frequency ranges 1 to 10 kc/s and 5 to 70 kc/s sweeping the respective bands repeatedly, and their outputs are displayed on intensity-modulated cathode-ray tubes which are photographed on slowly moving film. Observations have been carried out since June 1958, and it appears that the results provide an excellent experimental basis for comparisons with the mode theory of v.l.f.

ionospheric propagation. It is found that the frequency spectrum of distant atmospherics indicates a pronounced absorption near 3 to 5 kc/s, a broad intensity maximum around 10 to 20 kc/s, and a general decrease towards higher frequencies with undulating peaks. The selective absorption bands appearing in the spectrum are variable according to the time of day and seasons. These changes may be interpreted loosely as an ionospheric effect which is associated with the cutoff frequency of the waveguide bounded by the earth and the ionosphere. The solar flare effect on v.l.f. atmospherics propagation is also revealed, which indicates a sudden shift of the spectrum to higher frequencies owing to the increase of ionization and the lowering of a reflecting height of the ionosphere.

551.5

8427 A PRELIMINARY METEOROLOGICAL STUDY OF THE ORIGIN OF WHISTLERS. C.P.Mook.

J. geophys. Res., Vol. 64, No. 7, 745-8 (July, 1959).

A possible unique source of whistling atmospherics is found to be the presence large cyclonic disturbances at the geomagnetic conjugate point of the whistler receiving station. The possible role of these cyclonic disturbances in producing narrow magneto-ionic duct propagating conditions is also discussed.

551.5

8428 CALCULATION OF THE PROPAGATION PATH OF WHISTLING ATMOSPHERICS. K.Maeda and I.Kimura.

J. atmos. terrest. Phys., Vol. 15, No. 1-2, 58-65 (Sept., 1959).

An approximate method is worked out of calculating the propagation path of a whistler by using Fermat's principle. The paths calculated under some appropriate assumptions of the electron density distribution above the ionosphere show appreciable deviations from the line of magnetic force and are generally asymmetric with respect to the magnetic equator. As to the frequency characteristics of the whistler path, the higher the wave frequency is, the more the wave travels inside.

551.5 : 621.391.822

8429 DETERMINATION OF THE AMPLITUDE-PROBABILITY DISTRIBUTION OF ATMOSPHERIC RADIO NOISE FROM STATISTICAL MOMENTS.

W.Q.Crichlow, C.J.Roubique, A.D.Spaulding and W.M.Beery.

J. Res. Nat. Bur. Stand., Vol. 64D, No. 1, 49-56 (Jan.-Feb., 1960).

During the I.G.Y., the National Bureau of Standards established a network of atmospheric noise recording stations throughout the world. The ARN-2 noise recorder at these stations measured three statistical moments of the noise: average power, average voltage, and average logarithm of the voltage. An empirically derived graphical method of obtaining an amplitude-probability distribution from these three moments, and its development, is presented. Possible errors, and their magnitudes, are discussed.

551.5 : 538.56 : 621.391.822

8430 EFFECTS OF HIGH-ALTITUDE NUCLEAR EXPLOSIONS ON RADIO NOISE. C.A.Samson.

J. Res. Nat. Bur. Stand., Vol. 64D, No. 1, 37-40 (Jan.-Feb., 1960).

High-altitude nuclear explosions over Johnston Island in August 1958 appear to have had a rather pronounced effect on the radio noise recorded at Kekaha, Hawaii. Graphs are presented showing the hour-to-hour variation of the noise during August at eight frequencies from 13 kc/s to 20 Mc/s. All frequencies seem to have been affected, and the drop in received noise power amounted to as much as 32 dB in the hour following the first explosion. The period of time over which abnormal noise conditions were observed suggests that high-altitude nuclear explosions may have a rather persistent effect on radio communications at certain frequencies.

551.5

8431 DAILY AND ANNUAL COURSES OF NATURAL ATMOSPHERIC RADIOACTIVITY. M.H.Wilkening.

J. geophys. Res., Vol. 64, No. 5, 521-6 (May, 1959).

Measurements of the radon-decay products in the atmosphere over a 6-year period have been made with a monitor which precipitates fine airborne particulate matter onto a moving metallic tape. A calibration of the apparatus showed that the mean value for radon content at Socorro, New Mexico, is 2.4×10^{-13} curie/l., with an average diurnal fluctuation of a factor of 3.1 between maximum and minimum values. The diurnal variation is attributed to the amount of vertical mixing due to eddy diffusion in the lower atmosphere. The gustiness in air motion near the ground is taken as a measure of the mixing that occurs, and it is measured with a hot-wire anem eter. An annual variation in the atmospheric radioactivity is found which gives values during the fall months that are about twice those during the spring. This variation can also be explained in terms of the mixing that occurs at low levels as judged from mean wind-spee data. Values for the coefficient of vertical diffusion are calculated from measurements of the exhalation rate of radon near ground level as determined from the monitor data. The mean value of the height-independent diffusion coefficient is 6.7×10^4 cm^2/sec. Maximum values of as high as 55×10^4 cm^2/sec are found in the late afternoon of the month of April. Minimum values of the order of 2.0×10^4 cm^2/sec are found in the early morning hours in the fall months.

551.

8432 STRONTIUM-90 CONTENT OF THE STRATOSPHERE. H.W.Feely.

Science, Vol. 131, 645-9 (March 4, 1960).

Data includes rate of release to troposphere and thence to the ground.

551.5 : 539.1

8433 THE INCREASE OF γ-RADIATION FROM THE GROUND IN SWEDEN (1950-1959) CAUSED BY FALLOUT FROM NUCLEAR WEAPON TESTS. R.M.Sievert.

Ark. Fys., Vol. 16, Paper 33, 349-52 (1960).

Since 1950, the γ-radiation from the ground, plus the cosmic radiation, has been continuously recorded by pressure ionization chambers situated at four stations in the central and northern parts of Sweden, while since 1953 two extra stations have been operated in the southern part of the country. No significant increase in the γ-level was observed before 1953. The first indication of a higher level was found in August 1953 after the thermonuclear test over the northern hemisphere. Details of this increase are given. During 1954 there was no change but in the middle of 1955 the July weapon tests caused an increased amount of fallout, particularly in the south. Similar amounts were observed in the summers of 1956 and 1957, causing a maximum increase of about 1.2 mr per week, or 10% of the natural background. In the rainy summer of 1958, the radiation rose to values of 20% higher than the natural radiation and the tests over the northern hemisphere in September—October 1958 added a further factor so that in May 1959 there was still a 10-15% higher level than before 1953. By September 1959, the level dropped off until it was only about 50% of the maximum observed. The results show that as far as the 1958 tests are concerned most of the radioactivity has come down within 6-8 months. Because the radiation shows an irregular distribution the number of recording stations has been increased to 30. The locations of the sites are given.

C.F.Barnaby

551.5 : 539.16

INCREASE IN C^{14} ACTIVITY SINCE 1954. See Abstr. 7499

551.5 : 532.6

8434 THE SHAPE OF RAINDROPS. D.M.A.Jones.

J. Meteorol., Vol. 15, No. 5, 504-10 (Oct., 1959).

An investigation of the physical shape of raindrops using two cameras at right angles is described, and the results are tabulated and graphed. The data included measurements of 1783 raindrops of which 569 were classified as spherical, 496 as oblate, 331 as prolate, and 387 unclassified. The sizes measured ranged up to 6.4 mm equivalent spherical diameter. It is concluded that there is a mean shape which varies uniformly with the mass of the raindrop, but that this shape is the result of oscillation about the mean.

551.5 : 537.59

COSMIC-RAY INTENSITIES AND LIQUID-WATER CONTENT IN THE ATMOSPHERE. See Abstr. 7440

BIOPHYSICS · PHYSIOLOGICAL PHYSICS

576.2

8435 NEW REFLECTION OXIMETER.

M.L.Polanyi and R.M.Hehir.

Rev. sci. Instrum., Vol. 31, No. 4, 401-3 (April, 1960).

It is experimentally shown that the ratio of light reflected by a nonhemolysed blood sample at two suitable wavelengths is a linear unction of the oxygen saturation. A simple instrument to determine oxygen saturation in vitro, based on these findings, is described.

61

8436 THE DESIGN OF CAESIUM SOURCES FOR TELETHERAPY. W.S.Eastwood.

Brit. J. Radiol., Vol. 33, 243-5 (April, 1960).

A review is given of some of the problems encountered in the design of a Cs^{137} source, for use in teletherapy, at A.E.R.E., Harwell. The salt chosen for the source was the sulphate. The size and shape chosen, to give a clinically useful dose-rate at a suitable source-skin distance, was a cylinder 7.0 cm long and 3.0 cm in diameter. It is pointed out that the heating generated by the betas from a 1500 c source will cause the temperature of the capsule to rise a degree or two above that of the surrounding material, but that this should help to prevent the condensation of moisture. Details are given of the preparation of the source capsule. The variation of dose-rate with total activity of Cs^{137} contained in the standard capsule is given for source strengths of up to over 2000 c at distances of 30 and 40 cm. For a 1000 c source the dose-rates in air at these distances are about 40 and 22 r per min respectively.

C.F.Barnaby

61

8437 THE USE OF A NEW MULTI-FIELD ISODOSE CONTOUR PLOTTER. J.L.Howarth and V.J.Pick.

Brit. J. Radiol., Vol. 33, 265-7 (April, 1960).

An analogue computer is described to obtain the isodose contour plot for a multifield quickly and accurately. The individual dose distributions are represented by analogue plates on which the dose at any point is represented by a voltage proportional to it. The accuracy of the method is at least as good as can be achieved by graphical methods. The great advantage of the plotter is the saving of time that can be effected. This makes possible the comparison of many different dose distributions which would otherwise not be attempted — an attraction for large radiotherapy departments.

C.F.Barnaby

61

8438 HEALTH PHYSICS INSTRUMENTATION. I.

D.Taylor.

Nuclear Pwr, Vol. 5, 147-8 (April, 1960).

This article starts a new series. It indicates the range of instruments that are needed by the Health Physicist and what they are required to do. A classification of instruments is suggested. This introductory article will be followed by articles dealing with detailed design of instruments.

C.F.Barnaby

61 : 539.1.07

EXIT DOSIMETER FOR EFFECTIVE PATIENT THICKNESS.

See Abstr. 7250

Hearing . Speech

612.7

8439 NEW INSTRUMENTS AND METHODS FOR SPEECH ANALYSIS. T.Sakai and S.Inoue.

J. Acoust. Soc. Amer., Vol. 32, No. 4, 441-50 (April, 1959).

Some important features involved in the zero-crossing waves of the signal generated by the human voice are described. The method of analysing the vocal sound by a sonagraph using the natural wave forms is compared with a new method using the zero-crossing waves. Next, three kinds of devices are described which were developed by the authors to analyse speech sounds. These include devices to analyse automatically the zero-crossing intervals, to display the zero-crossing waves in three-dimensional form, and to make a visible pattern of the zero-crossing waves. In this paper, as examples of an important application of these devices, the following are described: the results of analysis of vowels in the Japanese language, some characteristics of a number of groups of consonants (after the separation of the consonant and the vowel parts), and the discrimination of the nasal consonants, [m] and [n].

612.7

8440 SPEECH BANDWIDTH COMPRESSION THROUGH SPECTRUM SELECTION. K.D.Kryter.

J. Acoust. Soc. Amer., Vol. 32, No. 5, 547-56 (May, 1960).

PB word and sentence intelligibility tests were conducted with unfiltered speech and with speech filtered (1) by a 100-7000 c/s bandpass filter, (2) by a 100-1600 c/s bandpass filter, (3) by a 500-2000 c/s bandpass filter, (4) by a 1000-2500 c/s bandpass filter, and (5) by various configurations of one, two or three bandpass filters, each 500 c/s wide. The positions of the centre frequencies of the bandpass filters 500 c/s wide were systematically varied during the tests. If constant speech intelligibility is used as a criterion, the results indicate that the total "effective" bandwidth required for the best multiple pass band system is less than that required for the best contiguous pass band systems by a factor of 2. Also, a feature of the signal resulting from this multiple sampling in the frequency domain is that it sounds "natural" and the identity of a talker's voice appears to be maintained.

612.8

8441 ON THE PREDICTION OF FORCED-CHOICE AND PHENOMENAL-REPORT THRESHOLDS BY STATISTICAL DETECTION THEORY. R.H.Lyon.

J. Acoust. Soc. Amer., Vol. 32, No. 4, 508 (April, 1960).

In the range of guess probability from 0.07 to 0.6, for equal values of guess probability, the detection theory predicts a larger threshold for forced-choice testing than for yes-no testing. A reversed threshold shift is observed experimentally. For low values of guess probability generally found in yes-no methods, the theory may agree with experiment.

H.D.Parbrook

612.8

8442 INFLUENCE OF LOUD CONTRALATERAL STIMULATION ON THE THRESHOLD AND PERCEIVED LOUDNESS OF LOW-FREQUENCY TONES. M.Loeb and A.J.Riopelle.

J. Acoust. Soc. Amer., Vol. 32, No. 5, 602-10 (May, 1960).

Two experiments, employing different psychophysical procedures, were performed to measure the attenuation at intensities near the threshold due to the acoustic reflex. In both, a contralateral tone was introduced to activate a reflex and the resultant threshold shift for a test tone noted. Shifts observed were small and apparently inconsistent with findings of past experiments. Possible significance of the results was discussed. The hypothesis was advanced that the reflex, once activated, attenuated loud sounds more than faint ones. Two additional experiments employing a loudness-matching technique were devised as a test of this hypothesis. In both of these the apparent loudness of different test tones was noted in the presence and absence of a contralateral activating tone. Results were in accord with the prediction. Applications and further tests of the hypothesis are discussed.

Vision

612.8

8443 GREEN AND BLUE ELECTRORETINOGRAMS AT LOW LUMINANCES. M.Bittini and L.Ronchi.

Atti Fond. Ronchi, Vol. 15, No. 1, 53-61 (1960).

Electroretinograms were obtained with blue and green stimuli of varying luminance. The irregularities revealed are discussed in terms of rod-cone interaction.

R.A.Weale

612.8

8444 COLORS OF ALL HUES FROM BINOCULAR MIXING OF TWO COLORS. N.Geschwind and J.R.Segal.

Science, Vol. 131, 608 (Feb. 26, 1960).

Land has recently studied the perception of colours resulting from appropriate mixtures of two colours or of one colour and light from an incandescent lamp. In an "image situation", colours of all hues may result from such mixtures. The findings presented demonstrate that the mixing which Land accomplished by superimposing two projected images on a screen can be achieved when the two colour separation images are presented simultaneously but separately to the two eyes.

612.8

8445 SOME COMPARISONS BETWEEN THE RECOVERY AFTER GREEN PRE-ADAPTATION AND THE RECOVERY AFTER BLUE-GREEN PRE-ADAPTATION.

G.Venturi and G.Salvi.
Atti Fond. Ronchi, Vol. 15, No. 1, 85-9 (1960).

When a blue-green test-field is added to a green test-field the sensitivity of the dark-adapting eye is greater when measured with the sum of the two lights than when measured with the green light alone. Neural interaction is invoked to explain this observation [which is, however, explained easily if one assumes that the eye is very much more sensitive to the blue-green component than to the green one]. R.A.Weale

612.8

8446 DETERMINATION OF THE UNIT COLOUR COORDINATES FOR 27 NORMAL OBSERVERS. N.I.Speranskaya.

Optika i Spektrosk., Vol. 7, No. 5, 710-20 (Nov., 1959). In Russian.

A new determination is reported of the unit colour coordinates, using only the colour equation and energy measurements for a field of vision of 10°; 27 observers were employed, 23 of whom were women and 4 men. The results obtained agree satisfactorily with Stiles' results, obtained using 50 observers, in spite of the considerable differences in experimental conditions. The authors results, together with those of Stiles (Symposium on Visual Problems of Colour, National Physical Laboratory, Teddington, Middlesex, 1957), served as the basis of a table of the unit colour coordinates submitted for approval to the International Commission on Illumination in the summer of 1959. A.Tybulewicz

612.8

8447 MERIDIONAL VARIATIONS IN VISUAL ACUITY AND EYE MOVEMENTS DURING FIXATION. J.Nachmias.

J. Opt. Soc. Amer., Vol. 50, No. 6, 569-71 (June, 1960).

An attempt was made to evaluate the contribution of eye movements to meridional variations in visual acuity. The threshold background luminance was determined for the detection of a fine wire at different orientations and exposure durations. In addition, eye movements were recorded under comparable conditions in order to ascertain the magnitude of relative motion that retinal images of such wires undergo due to eye movements. It was found that acuity varies as a function of line orientation in a similar manner with all exposure durations. Differences in the effect of line orientation with different exposure duration appear to be unrelated to the variations in retinal image motion due to eye movements during fixation. It was concluded that for most indivuduals, the directional nonuniformity of eye movements during fixation is not sufficient to play any role whatever in the meridional variations in the visibility of visual detail.

612.8

8448 ANALYSIS OF EYE MOVEMENTS DURING MONCULAR AND BINOCULAR FIXATION.

J.Krauskopf, T.N.Cornsweet and L.A.Riggs.
J. Opt. Soc. Amer., Vol. 50, No. 6, 572-7 (June, 1960).

Recordings of the horizontal component of movements of the eyes were made during monocular and binocular fixation. The variation in the vergence of the eyes over time was found to be of the same order of magnitude as the variation in position of the individual eyes, even though the lateral positions of the two eyes are somewhat correlated. The drift and tremor of the two eyes are not correlated; the over-all correlation is due to the saccadic movements. Saccades in one eye seem to be always accompanied by simultaneous saccades in the other eye which are almost always in the same direction and about the same in size. The maintenance of binocular fixation does not seem to be dependent on a direct response to or sensing of vergence error. Rather, it appears to be dependent on the saccadic responses of the two eyes to their own fixation errors.

612.8

8449 ENHANCED CONTRAST OF AN INDEFINITELY CONTOURED OBJECT BY MOVEMENT OR INTERMITTENT ILLUMINATION. M.Bittini, A.M.Ercoles, A.Fiorentini, L.Ronchi and G.Toraldo di Francia.

Atti Fond. Ronchi, Vol. 15, No. 1, 62-84 (1960).

Movement of an object or intermittent illumination both serve to enhance the perception of contrast. In the former case there is a minimum angular rate of fall of the intensity of the contrast band which decreases with the amount of movement. R.A.Weale

612.8

8450 COURSE OF THE POTENTIAL CHANGE IN THE HUMAN ELECTRORETINOGRAM DURING LIGHT ADAPTATION. H.Kawabata.

J. Opt. Soc. Amer., Vol. 50, No. 5, 456-61 (May, 1960).

The positive potential of the E.R.G. shows a decreasing course during light adaptation when the difference between the intensities of the test and adapting light is large. This is contrary to psychophysical measurements. In the human E.R.G., a test light of large area and high intensity is generally required to elicit adequate potentials, while psychophysical measurements of light adaptation use relatively weak test flashes to measure sensitivity by means of the difference threshold. If the intensity of the test light is reduced, or that of the adapting light is increased, the decreasing course of the E.R.G. becomes less apparent, and when a red test light is used, the curve even shows a slight increase. When a red test light now is used on a weak adapting field, the E.R.G. reveals both an x wave and a b wave. The curve of the x wave shows a slight increase, while the b wave shows a decreasing course. An analysis has been made of the differences among light adaptation curves of the human E.R.G. measured under the conditions, as compared with psychophysical measurement. It is suggested that the differences reflect the relative contributions of the photopic and scotopic mechanisms of the eye

612.8

8451 STUDIES ON DARK ADAPTATION. III. PRE-EXPOSURE TOLERANCE OF THE HUMAN FOVEA AS MEASURED BY CONTRAST SENSITIVITY.

J.W.Wulfeck, D.E.Johannsen and P.I.McBride.
J. Opt. Soc. Amer., Vol. 50, No. 6, 556-8 (June, 1960).

For Pt II see Abstr. 5577 of 1956. The effect of pre-exposures of brief duration and relatively low brightness on the contrast sensitivity of fovea was investigated. Monocular measurements on two observers were made with a centrally fixated one-degree square testpatch against a surround 27° in diameter. First the contrast threshold was measured after 10 min of adaptation to brightnesses of 0.010, 0.10, and 1.0 ft L. Then the course of adaptation was measured by the contrast threshold after pre-exposures which immediately followed the aforementioned adaptation brightnesses. (Adaptation brightness served as the background brightness for the contrast threshold). The pre-exposures were 0.10, 1.0, and 10 ft L for 1, 10, and 100 sec. Not all combinations of adaptation brightness and pre-exposure were used. Contrast threshold increased as background brightness increased and the eye's sensitivity to contrast decreased with increasing duration and brightness of pre-exposure above a critical value of 100 ft L sec.

612.8

8452 STUDIES ON DARK ADAPTATION. IV. PRE-EXPOSURE TOLERANCE OF THE DARK-ADAPTED PERIPHERAL RETINA. J.A.Hanson, J.W.Wulfeck and E.M.S.Anderson.

J.Opt. Soc. Amer., Vol. 50, No. 6, 559-61 (June, 1960).

The effects of low-brightness short-duration pre-exposures on peripheral dark adaptation were investigated. Three peripheral locations: 2 deg, 6 deg, and 18 deg, were tested with a square 1 deg test patch of 0.033 sec duration. Pre-exposure was to a centrally fixated circular field which subtended 55 deg diam. Monocular curves were obtained after pre-exposures of 0.01, 0.1, 1, and 10 ft L each presented for 1 and 10 sec. All pre-exposure conditions resulted in some loss of sensitivity at the 2 deg location; pre-exposure combinations of 0.01 and 0.1 ft L sec resulted in little if any loss of sensitivity at the 6 and 18 deg locations.

612.8

8453 MINIMUM DETECTABLE DARK INTERVAL BETWEEN TRAINS OF PERCEPTUALLY FUSED FLASHES.

M.Lichtenstein and R.Boucher.
J. Opt. Soc. Amer., Vol. 50, No. 5, 461-6 (May, 1960).

The minimum detectable dark interval between trains of perceptually fused flashes of light was investigated. The lengths of this minimum interval between such trains was an inverse function of both train duration and of pulse rate within the train. Trains longer than a critical duration of 70 or 80 msec did not further decrease the dark interval duration. Also, an It = k law is approximated in that any constant amount of light energy in the fused trains, regardless of its time distribution within the critical duration, produces a constant value of minimum detectable dark time between trains. Results are discussed in relation to action of light quanta in the timulus, neural summation, and neural latency changes, all of which, is contended, jointly contribute to production of the psychophysical results of the experiment.

612.8

8454 ENTOPTIC SCATTER AS A FUNCTION OF WAVELENGTH. D.W.DeMott and T.P.Davis.

J. Opt. Soc. Amer., Vol. 50, No. 5, 495-6 (May, 1960).

The transmission of an excised steer eye was measured for directly transmitted light and also for directly transmitted plus scattered light. In this way the total scatter over a wavelength range 0.35 to 1.3 μ was obtained. W.T.Welford

612.8

8455 SEARCH IN AN UNSTRUCTURED VISUAL FIELD. E.S.Krendel and J.Wodinsky.

J. Opt. Soc. Amer., Vol. 50, No. 6, 562-8 (June, 1960).

Search in an unstructured visual field is an independent random process under the conditions described in this paper. The basic data for this report are 3072 search trials for each of four practised observers. The four targets were circular and intercepted angles of 4.8', 13', 24', and 46'. Four search areas which measured 0.011, 0.084, 0.26, and 0.48 sterad, and four values of background luminance 0.01, 0.1, and 12.4 ft L were employed. Four contrasts were used for each of the 16 target size and background luminance conditions. These contrasts were generally at least twice the 95% threshold contrast. The data for the four subjects were combined, and since a one-parameter distribution was an adequate description, the mean time to detection has been tabulated for the 64 different experimental conditions to summarize these findings.

612.8

8456 STANDING POTENTIALS OF THE FROG'S EYE. E.Dzendolet.

J. Opt. Soc. Amer., Vol. 50, No. 6, 551-5 (June, 1960).

With the in-place frog's eye, the potential difference between the centre of the corneal surface and the rest of the cornea reached a maximum of about -15 mV at the corneoscleral junction. This large a corneal potential difference may be the immediate source of the potential presumably utilized in the electro-oculogram, rather than the cornea-to-fundus potential. A slightly injured section of the cornea and also the aqueous humor had a potential of approximately +15 mV with reference to the corneal centre. These two potentials appeared to be separated by an insulating layer, presumably the interface between the corneal epithelium and Bowman's membrane. The potential difference between the corneal centre and the front interior part of the lens was about -33 mV, and about -47 mV for the back. The vitreous side of the retina was about -2 mV. Within the retina, transient steps of about -50 mV occurred. These were not the same shape or in the same order from frog to frog, or from one place in the same retina to another, except for one. This was a step of -40 to -60 mV which was presumably Brindley's R membrane.

TECHNIQUE . MATERIALS

62

8457 SEPARATION OF MINERALS IN A STREAM OF IONS PRODUCED BY α-RADIATION.

I.N.Plaksin and L.P.Starchik.

Dokl. Akad. Nauk SSSR, Vol. 131, No. 1, 85-6 (March-April, 1960). In Russian.

Ionization produced by α-radiation from Po^{210} in an electrode gap was used to charge mineral particles in an electro-separator. With this method larger currents were obtained and at lower voltages than those used in the normal separator employing corona discharges. Z.Krasucki

62

8458 MANIPULATION OF CESIUM. P.Leliak.

J. appl. Phys., Vol. 31, No. 3, 609 (March, 1960).

Because caesium reacts vigorously with air it was previously necessary to break open caesium ampoules in an inert atmosphere. It has now been found that if the ampoule is cooled in liquid nitrogen it can be opened in air. At low temperatures the oxidation rate seems negligible and as the caesium gets hotter a protective film builds up so that it can return to room temperature without an explosive reaction. D.Walsh

62

8459 PREVENTION OF THE DEVELOPMENT OF COLORATION IN SILICA GLASS ON IRRADIATION WITH NEUTRONS BY PRETREATMENT IN AN ELECTRIC FIELD AT HIGH TEMPERATURE. J.Yovanovitch.

J. Phys. Radium, Vol. 18, No. 11, 640-1 (Nov., 1957). In French.

669 : 539.2 : 537.32

THE SINTERING OF BISMUTH TELLURIDE. See Abstr. 7972

62

8460 DEVICE FOR ULTRA-HIGH-PRESSURE HIGH-TEMPERATURE RESEARCH. W.B.Wilson.

Rev. sci. Instrum., Vol. 31, No. 3, 331-3 (March, 1960).

A new device has been developed for materials research at high pressures and high temperatures. The unit may be described as an extension of the Bridgman "anvil", modified to permit internal heating. The principle of "massive support" is retained with pressure being achieved through the elasticity of multiple binding rings, rather than through the "compressible" gasket effect. The unit has been calibrated to pressure beyond 100 000 atm with temperature to 2000° C. The operational characteristics of the device and problems associated with high-pressure high-temperature research are discussed.

62 : 621.365.3

8461 RESISTANCE-HEATED HIGH VACUUM FURNACE FOR TEMPERATURES TO 1400° C. J.Cohen.

Rev. sci. Instrum., Vol. 31, No. 3, 267-70 (March, 1960).

An experimental high-vacuum furnace with a platinum—rhodium resistance heating element is described; it is operable also in oxygen or other gases up to pressures of at least 10^{-3} mm Hg. The furnace is assembled from readily obtainable equipment, and knife-edge vacuum seals are used throughout. The uniform hot zone is approximately $1\frac{9}{32}$ in. in diameter and 2 in. long. The power required for 1400° C, the maximum safe operating temperature, is about 1 kW; at this temperature the pressure is $\sim 10^{-8}$ mm Hg. This furnace is suitable for electrical conduction studies as well as for heat treatment, etc.

669

8462 REACTION OF INDIUM SOLDER WITH MERCURY TELLURIDE. S.Nielsen.

Brit. J. appl. Phys., Vol. 10, No. 8, 380-1 (Aug., 1959).

Preliminary observations on the rate of reaction between In and specimens of mercury telluride are presented. Sn, which did not react, was found to be a satisfactory solder for making electrical contacts. G.C.Williams

669

8463 KINETICS OF SINTERING OF SODIUM CHLORIDE IN THE PRESENCE OF AN INERT GAS.

J.B.Moser and D.H.Whitmore.

J. appl. Phys., Vol. 31, No 3, 488-93 (March, 1960).

Direct observations of interfacial growth and the approach of centres between spheres of sodium chloride were made in an argon atmosphere and over a temperature range of 700 to 800° C. The rate law governing the increase of the contact area between spheres, the effect of changing size scale on this rate and the absence of a change in the centre-to-centre distance during sintering all indicate that the rate-determining mechanism of material transport in this sintering process is evaporation-condensation. A model is presented which considers Stefan flow to occur within a thin boundary layer in the gaseous phase adjacent to the condensing surface, the sintering rate being predominantly governed by the rate at which sodium chloride vapour diffuses through this boundary layer. The marked pressure-dependence of the empirical relationship between contact area and sintering time for fixed temperature and sphere size is consistent with the proposed model

669

8464 **SINTERING OF URANIUM OXIDE IN HYDROGEN AT 1350°C.** A.Bel, R.Delmas and B.François.
J. nuclear Mater., Vol. 1, No. 3, 259-70 (Oct., 1959).

Sintering in argon of oxides of large specific surface area produces a more coarse-grained product (5-10 μ) than does hydrogen sintering; the density is the same in each case. Departure from stoichiometric composition of the powders does not appear to influence the density of the sintered compact. The sintering, in hydrogen, of various oxides of large specific surface area, obtained from ammonium uranate and uranium peroxide, was studied in a systematic way. With a given specific surface area, the final densit varied as a function of the sintering temperature, with a maximum density for a particular temperature. This temperature is lowest when the specific surface area of the powder is the greatest. A process is described for the preparation of uranium oxide powder from ammonium uranate and its sintering in hydrogen at 1350°C; in this way a fine-grained product of density 10.6 can be obtained.

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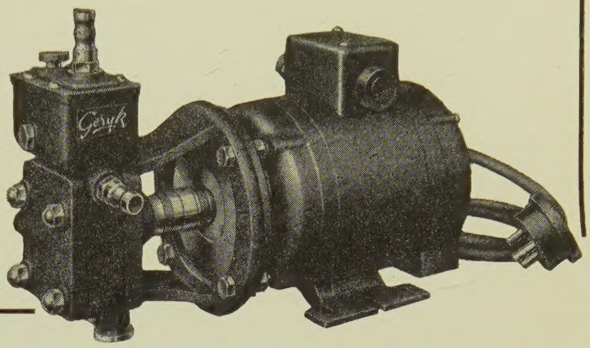

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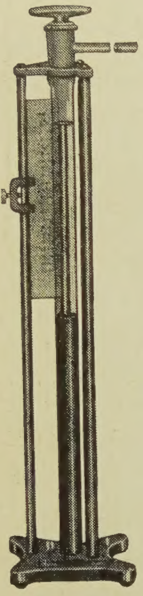

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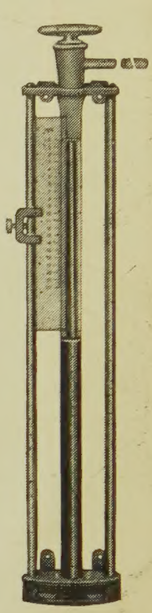

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